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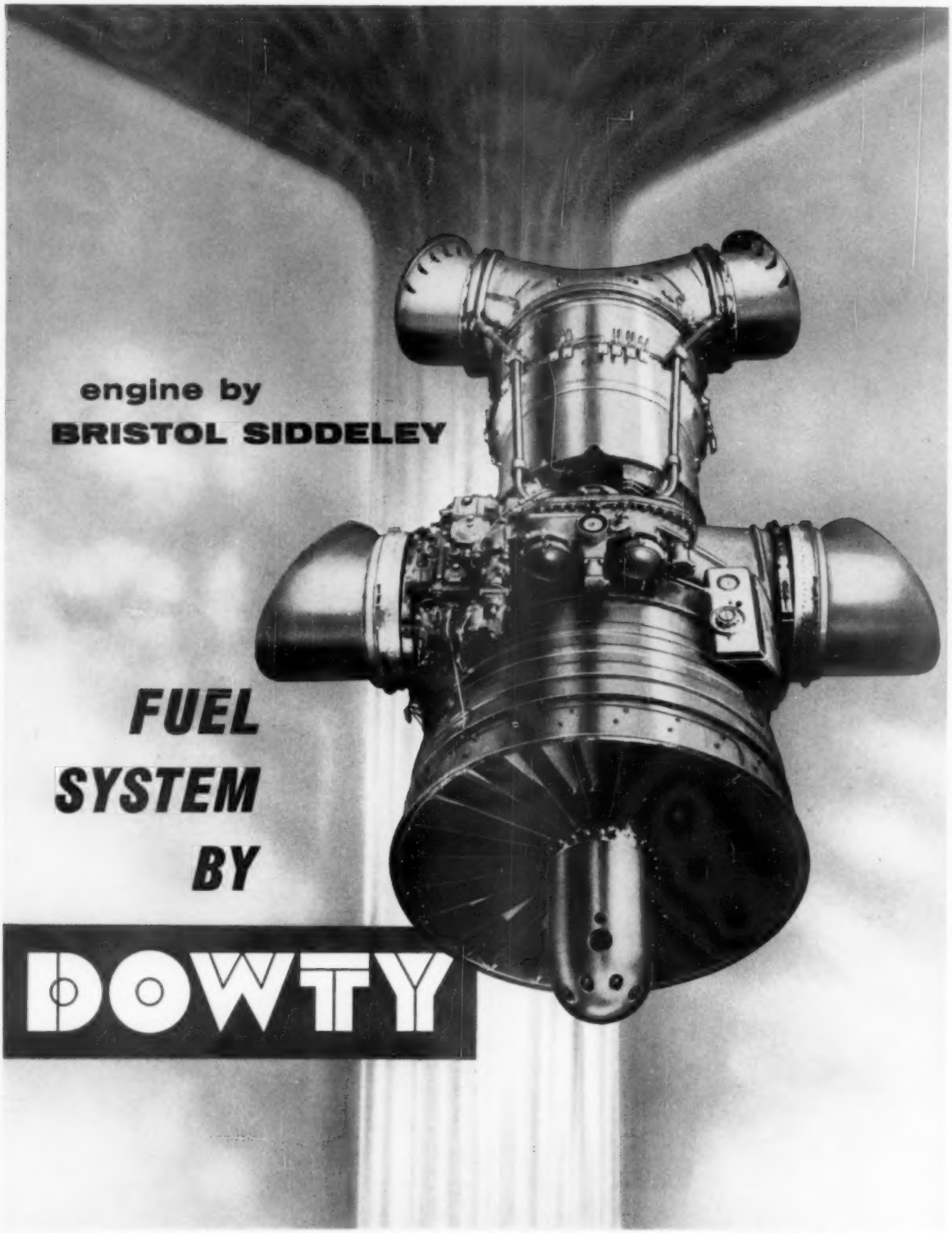

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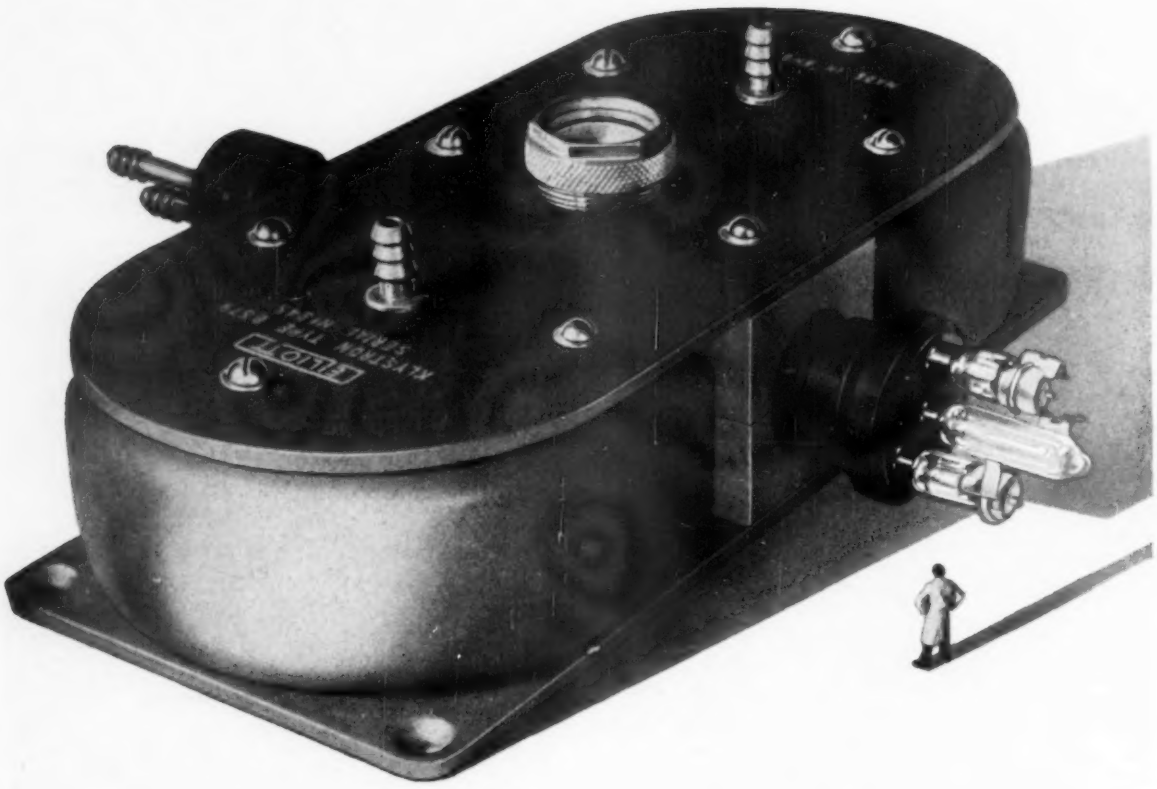

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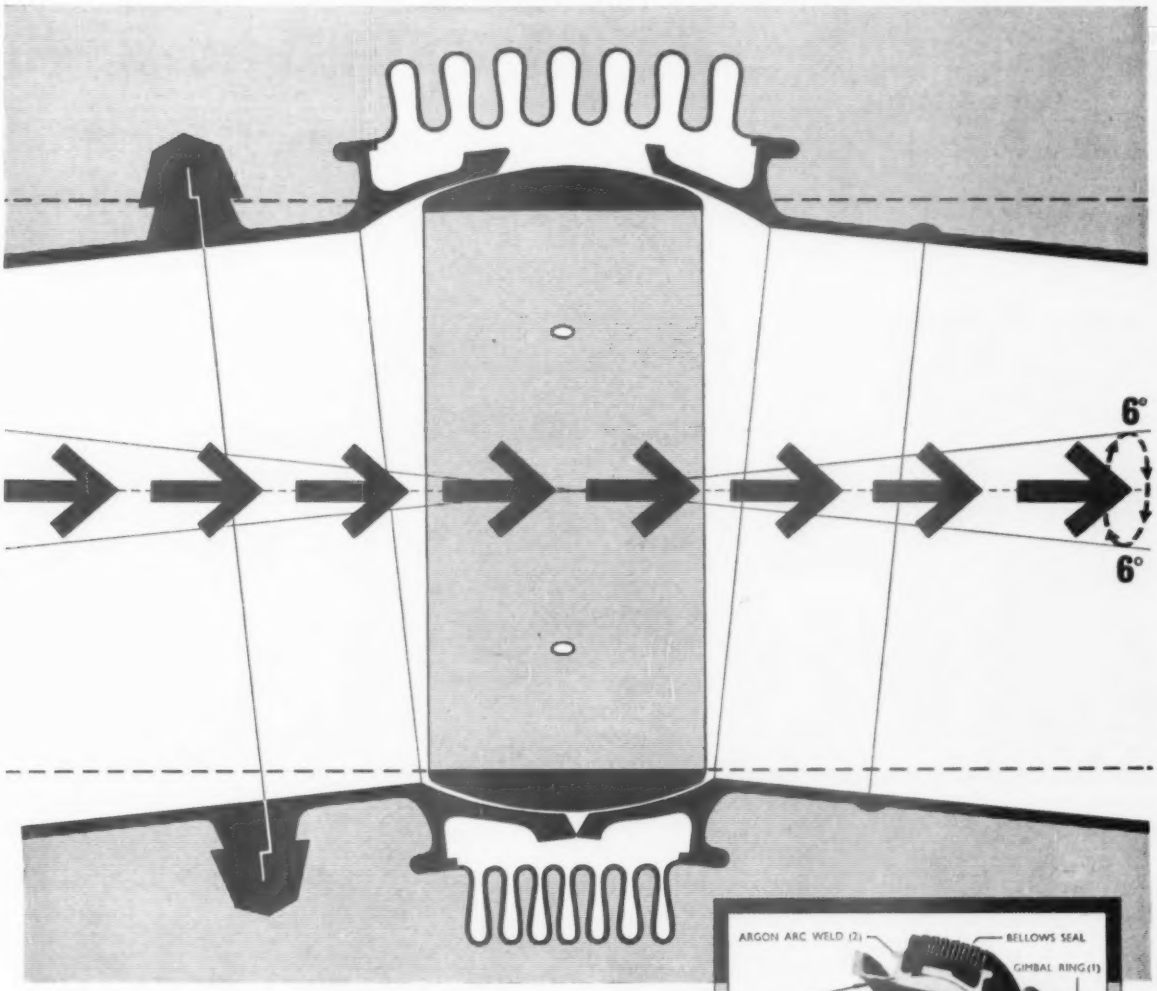

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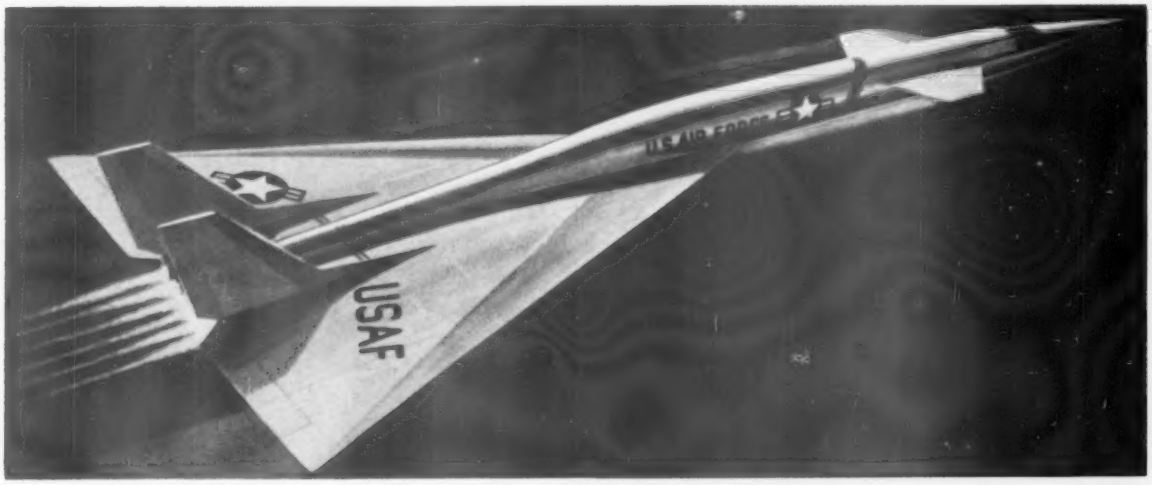

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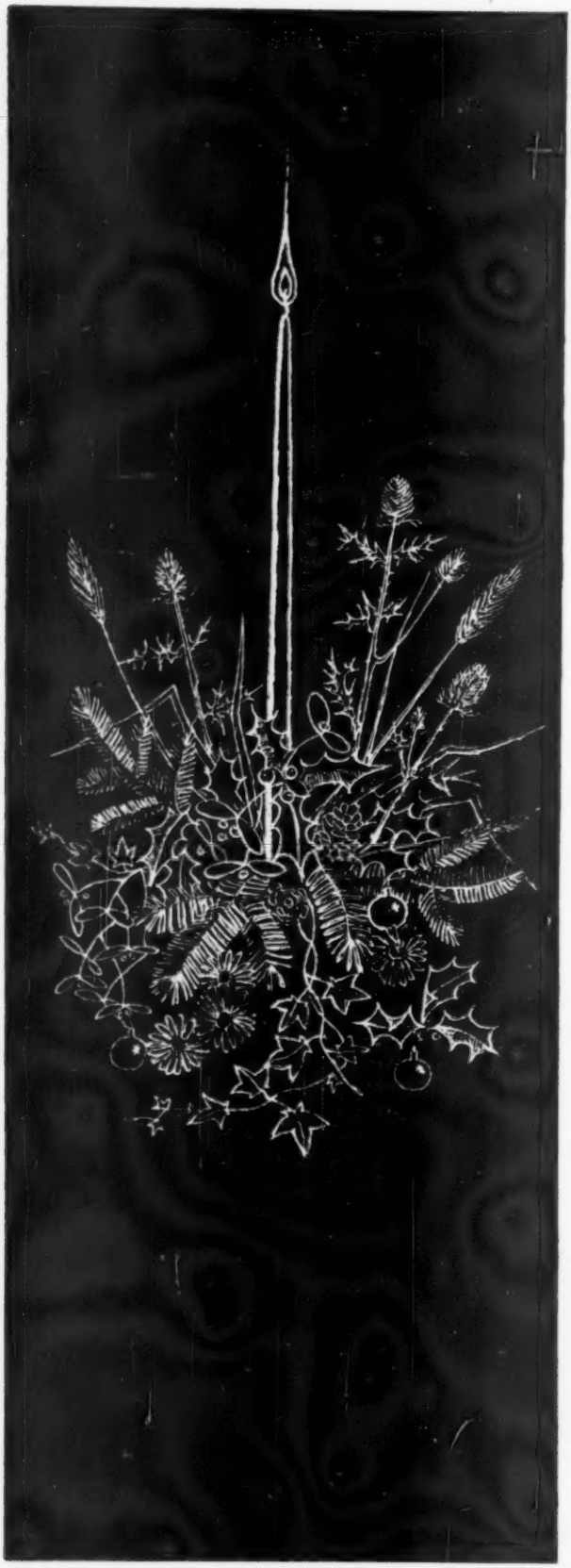

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for Christmas
and the New Year
from
**BRITISH
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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2565 DECEMBER 16, 1960

Supersonics and Civil Aviation

Towards the end of last week, newspaper reports from America alleged that positive steps had been taken towards an Anglo-U.S. agreement on collaboration in the matter of supersonic airliner development. It was said, in fact, that the American Government had decided in favour of providing financial help for the U.S. industry in its development of such a craft and that agreement had been reached in principle regarding collaboration with the U.K. This, it was said, would envisage production in both countries.

Neither the Ministry of Aviation nor the British Aircraft Corporation were able to throw any light on this "agreement." Nor could they say whether anything new in this direction had materialized. Indeed, it seemed fairly clear that by "in principle" is meant no more than that the agreement exists only as a mutual desire—at Government level—which will need a great deal of close consideration before even an initial positive approach towards its fulfilment can be made.

Meantime, the view in this country is hardening towards the selection of the Mach-2.2 airliner as the current solution—as much for reasons connected with the selection of structural materials as for the reason that the airlines and traffic controllers and airport authorities will find that class of supersonic vehicle as much as they can handle. The U.S. manufacturers, conscious of the fact that the U.S.A.F. is flying Mach-2 bombers are not quite so definite. Curiously enough, for all the flexibility of outlook for which Americans are famed, we have heard little about a possible VTOL supersonic U.S. contender. As is customary in this country, where so much successful pioneer work has been done, there seems to be a danger that we may rest too long on our oars.

Landing Charges Under Fire

Battle has been joined between the airline operators and the British Government. As we report in this issue (p. 790), the director-general of I.A.T.A., Sir William Hildred, has been requested by the Charges Committee of the Association to present their case to the Minister of Aviation early in the New Year. It will be no new experience for Sir William to undertake negotiations of such importance, but in this case the situation is as piquant as when a poacher turned gamekeeper falls in on his old friends up to their tricks. Sir William, it will be recalled, was a distinguished member of various U.K. Government departments until his retirement in 1946.

Now if only L.A.P. were run, as we have been suggesting for so long, as an independent authority, even if these negotiations had come about, it would have been a case of one commercial undertaking negotiating with another. Now, if I.A.T.A. fails to achieve the result which it desires with M.o.A., its member airlines will be free to invoke the aid of their respective governments.

That would indeed be a case of a sledge-hammer being used to crack a nut. There would be every danger of losing sight of the real problem. And that should not be too difficult to solve: How to extract more commercial revenue out of an activity which should have many lucrative concessions to let. And, of course, there is the likelihood that an independent authority would be able to run the airport on a tighter budget and with fewer personnel.

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Matters of Moment

More Money For MAPAG

IT has now been officially disclosed by the Royal Aeronautical Society that the donor of a recent generous gift to its Man Powered Aircraft Group fund—first mentioned in our issue of Nov. 25—is Mr. H. Kremer. Having already most generously presented £5,000 as a prize for the first successful man-powered aircraft fulfilling the requirements of a competition drawn up by the Royal Aero Club, Mr. Kremer has now given a further £2,500. This is a donation to the fund which is being built up to provide financial assistance to those, with promising man-powered aircraft projects, who might otherwise not be able to take part in the competition. Some half-dozen projects are, we believe, at present being considered by the Group committee.

With this handsome sum to augment the hitherto small fund, it may well be that other individuals and companies will be stimulated to add their share of financial encouragement to what has become a serious effort. Although, for obvious reasons, details cannot be given of the various projects already under way, it can be said that several of them are by small teams of experienced aeronautical engineers as well as students. Among them are some extremely promising solutions and the competition is likely not only to result in some interesting craft, but to contribute a great deal of new information on lightweight structures and low-speed aerodynamics.

Mr. Kremer's new gift is a splendid gesture of faith. It will do much to help the R.Ae.S. to aid the many serious students of manpowered flight.

Landing Charge Increases Attacked

LAST week the Ministry of Aviation's decision to increase the landing fees at its airports from April 1 next year became the subject of international protest. The 20 airlines which use British airports—and L.A.P. in particular—have asked the International Air Transport Association to make official representations to the Minister of Aviation.

Obviously the Ministry must do its best to make the U.K. airports less of a load on the taxpayer and no one would be likely to object to this very natural wish. But the airlines feel that there must be something wrong with the running of this series of airports if, in order to get only a little nearer to viability, they must charge landing fees which are among the highest in the World.

Following a series of discussions in London the 20 airlines have asked IATA's director general, Sir William Hildred, to present their case to the Minister early in the New Year. Speaking for the airlines, Mr. R. L. Cole, of P.A.W.A., said that the new charges involved matters of principle which would

Aero Events of the Week

At the R.Ae.S. supersonic transport symposium on Dec. 9 were, top, left to right, Mr. K. G. Wilkinson, of B.E.A.; Mr. W. B. Lewis, of M.o.A. and Mr. G. H. Lee, of Handley Page. Co-chairman of the symposium was Mr. M. B. Morgan (above, centre) M.o.A. deputy controller of aircraft (R. & D.). With him here are Dr. N. J. L. Megson (left) of M.o.A., and Mr. C. H. Jackson (right) of B.O.A.C.

Above, Rear Admiral J. A. levers, deputy controller of aircraft, M.o.A. (right), at the de Havilland Engine Co. With him here, left to right, are Mr. W. F. Shaylor; Mr. G. N. Pollock; Dr. J. W. Drinkwater and Mr. Hugh Buckingham.

Above, Mr. D. Keith-Lucas (left) and Mr. F. H. Robertson (third from left) show a Short Skyvan component at Belfast to Mr. M. D. Day (second, left) and Mr. Nichol (right) of Silver City Airways.

Left, Sir George Gardner, controller of aircraft, M.o.A., arriving at Filton for a visit to Bristol Siddeley. He is being greeted by Mr. A. Eustace (left) and Sir Arnold Hall (centre).

FAREWELL AND HAIL.—A party was held in London at Canning House on Dec. 9 to bid Godspeed to Air Cdre. and Madame A. R. Sola Claret, the departing Argentinian Air Attaché (left) and to welcome his successor, Air Cdre. and Madame J. F. T. Buden (right).

have World-wide repercussions. The increase followed one of 28% last year and of 50% three years ago—a total increase of 150% in less than four years which made London Airport "the most expensive in the World."

B.E.A. has decided, as reported on p. 794, to increase its domestic tourist-class fares by about 3½% as from next April. The interesting point here is that, though the great majority of U.K. airports used by B.E.A. are Ministry owned and operated, two important ones—Manchester's Ringway and Birmingham's Elmdon—are municipally owned, though with arrangements by which the Ministry provides technical and financial aid. It is most unlikely, however, that these or other owners will choose to make charges which are out of step with the Ministry schedules. In any case, the new schedules (if they come into force) only affect aircraft with gross weights greater than 26,000 lb.

Meanwhile, it has yet to be seen whether the Government is determined to stand by its decision to introduce questionnaires for the use of incoming and outgoing long-haul passengers. The forms—which the Government consider to be essential for information and statistical purposes—would have been introduced before now had it not been for the airlines' protests. It may be necessary to make their distribution and completion a statutory requirement, unless the airlines agree, or the form filling is made an essential formality at British airports.

An Ogee Wing for the FD.2?

A CONTRACT is under negotiation for Bristol Aircraft to modify a Fairey FD.2 as part of its supersonic-airliner research programme. Apparently it is intended to install an ogee wing on the aircraft. This would permit test-flying experience to be gained at high supersonic speed.

Basically a slim-delta with streamwise tips, the ogee wing takes its name from the "elongated-S" shape in plan view of its leading edge. (An ogee is an S-shaped line.)

Low-speed tests with highly swept wings are now being made at Bedford with the Short SB.5; its wing sweep is now 69°. Tests with a true slim-delta will be made early next year when the Handley Page H.P.115 research aircraft flies. But there is a gap at the supersonic end of the scale which may well be filled by tests with a modified FD.2. With its original wing this aircraft set up a World speed record of 1,132 m.p.h. in 1956.

The ogee wing is one of the highly swept delta wings with very low aspect ratio which are being proposed for supersonic airliners. Slender wings of this type have subsonic leading-edges and supersonic trailing-edges. Usually the leading-edge is curved, with streamwise tips because this helps in designing for low drag. Leading- and trailing-edges are sharp.

Airflow past wings of this type is different from flow over conventional wings. In all flight conditions there is flow separation from all edges; in other words, the wing is "stalled." Separation leads to the formation of vortex sheets.

Under supersonic cruise conditions there are no shock waves over the wing; shocks are limited to a weak bow wave and another weak shock system behind the trailing-edge. Flow over the wing is similar at supersonic and subsonic speeds. In spite of the wing's low aspect ratio, good take-off performance and low approach speeds are possible because the vortex system produces a large lift force.

Bristol ideas on the use of the slender wing to produce a practical supersonic airliner are described on p. 808.

Fairey Affairs

ALTHOUGH the name of the Fairey company is no longer directly connected with the aircraft industry, its aeronautical associations are by no means at an end. This was made clear last week in the annual report to the shareholders, presented by Mr. G. W. Hall, F.R.Ae.S., chairman of the Fairey Co., Ltd.

So far as Fairey's overseas companies are concerned, the chairman reported a successful year for the Fairey Aviation Company of Canada, Ltd., now firmly established on the west coast of Victoria as well as at Halifax, Nova Scotia. Fairey Aviation Company of Australasia Pty., Ltd., at Bankstown and Adelaide "has continued to increase its turnover in aircraft and other fields."

Avions Fairey S.A. in Belgium, on the other hand, is reported to have had a somewhat difficult year. The company, in association with S.A.B.C.A., was awarded a contract for a long-term manufacturing programme of NATO Starfighters. Soon after starting this work, however, because of the troubles in the Congo it was brought temporarily to a halt and this was a serious setback.

Speaking of the Fairey company's long-outstanding claim for settlement of their Great West Aerodrome sale to the Government Mr. Hall said that a contract had now been signed. This agreed to a sale on the basis of terms equivalent to those which would have been obtained if the land had been compulsorily acquired by the Government on the agreed date. He said that the loss of the Great West Aerodrome (now London Airport) "without doubt progressively weakened our aviation business to the point when we were virtually unable to remain in the industry."

France, Britain and the Blue Streak

THE fact that Mr. Peter Thorneycroft, Minister of Aviation, flew to Paris on Dec. 12 for further talks with French Government officials concerning the possible development of an all-European heavy satellite launcher, made it clear that the French had not at that time turned the proposition down as had been reported from Paris the preceding week. The sum of money involved in producing a multi-stage space booster, using the Blue Streak as the first stage, is understood to be in the region of £65 million. It is believed that France is being asked to contribute about a quarter of this sum; other European countries are also being invited to participate, together with Australia and Canada.

If agreement is reached to go ahead, the Blue Streak combination may be offered to the European Space Research Organization which 11 countries—including Britain and France—have decided to form. As we explained last week, this group is restricting its activities to space payloads; Mr. Thorneycroft's proposed "Space Booster Club" is an entirely separate issue.

Meanwhile, Mr. Airey Neave, M.P., chairman of the All-Party Committee on Space Research, which met under the auspices of the British Interplanetary Society on Dec. 1, is to raise the question of communication satellites and Britain's participation in space-technology in the House of Commons before Christmas. The Committee is preparing a memorandum drawing attention to the urgent "industrial and economic implications of satellites for telephone and TV communications," with particular emphasis on commercial developments now taking place in the United States.

Opposing Military Strengths

FOR the second year in succession, the Institute for Strategic Studies has published a pamphlet ("The Military Balance") giving an approximation of the military strengths of the Soviet bloc, NATO, CENTO and SEATO. Despite its imposing title, the Institute appears to be a private organization and would therefore not have access to official figures. Its data are consequently derived from published sources, with all the weaknesses thus implied in the Communist compilations.

As an example, the figure of 20,000 aircraft in the Soviet Air Force has been quoted unchanged for at least the past five years, and can be true in only the broadest possible terms. Nor is any individual breakdown of the satellite forces attempted, but within these limitations, the pamphlet has some use as a single reference for a number of estimates. The compilers are wise in resisting the temptation to quote what are almost certainly spurious designations for Russian missiles, published in the popular Press.

Turning to the Alliances of the Free World, the strength figures can be seen to be much more authoritative, although a cursory glance reveals several anomalies. The navies of the eight Atlantic maritime nations are credited with about 28 aircraft carriers, but the U.S.N. alone has 26 of these ships in service, and the R.N. has six. In addition, it is hardly true to say that Fairey Gannets are being replaced by Sea Vixens and

Scimitars for anti-submarine duties, which in fact have been taken over by helicopters in the R.N.

Analysis of NATO air force strengths is patchy, sometimes types of equipment being mentioned but, more often, not. And the authoritative nature of the information is not strengthened by such mis-designations as the F-105 Thunderbird, when Thunderchief is meant, and the lack of full nomenclature for the F-102 Delta Dagger and F-106 Delta Dart. It would also be nice to see the F-101 Voodo with its full complement of "Os."—J.E.F.

Dropping the First A-bombs

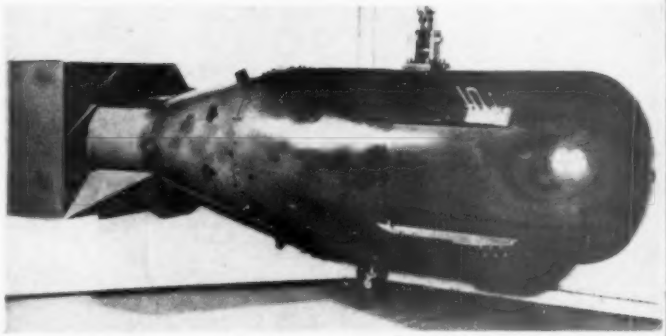
PHOTOGRAPHS which have finally been published of the first operational atomic bombs, dropped over Japan by the U.S.A.A.F. in mid-1945, provide an opportunity of recording some details of their release. Between them, the two 20-kiloton weapons killed about 150,000 people, and were instrumental in the surrender of Japan.

Development of the first atomic bomb from mid-1943 onwards was related specifically to the Boeing B-29 Superfortress, which was the only aircraft capable of carrying it over the required ranges. The U.S.A.A.F. was responsible for developing the aircraft as an atomic weapons system and for forming the first operational unit, which was the 393rd Bomb Squadron (VH), of the 509th Composite Group. This was formed at Wendover, Utah, by Col. Paul W. Tibbets, on Dec. 17, 1944.

In all, 15 B-29s were produced for atomic attack, without gun armament except in the tail. They departed for Tinian, in the Marianas in May, 1945. After high-altitude navigational and simulated atomic sorties over Japan, during which 10,000 lb. TNT-filled light-case replicas of the nuclear missiles were dropped, Hiroshima was designated as the primary target, being the largest unbombed Japanese city.

Two atomic bombs—the uranium weapon known as "Little Boy" and the plutonium "Fat Boy"—had been ferried to the Pacific by sea and air, and the first was loaded in the B-29 "Enola Gay" for take-off on Aug. 6, 1945. Its 9,700 lb. weight included 137.3 lb. of uranium 235, and it was dropped by Major T. W. Ferebee from Col. Tibbets' B-29 at 31,600 ft. and a ground speed of 328 m.p.h. At 800 ft. over Hiroshima its tail aerials received the detonation signal which fired the two parts of the uranium charge together and started the fission process 1/1,500th of a microsecond later. It laid waste 4.7 sq. miles of the city and killed 70,000 people.

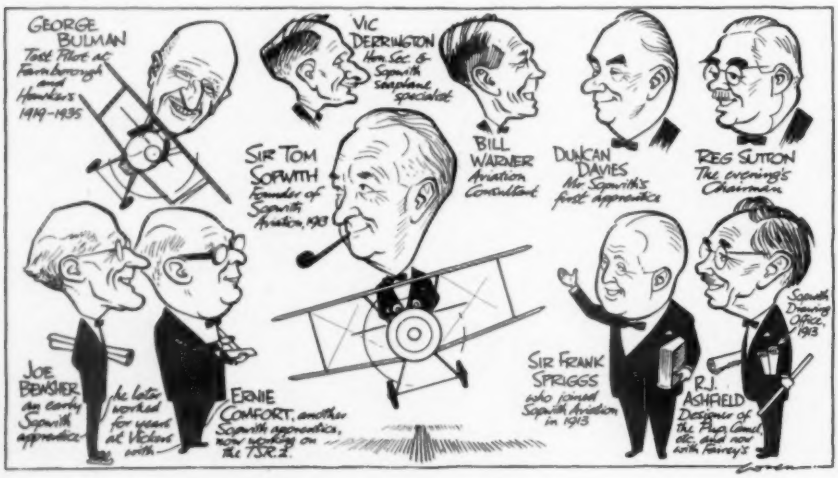
On Aug. 9, the plutonium bomb was released from the B-29 "Bock's Car," flown by Major Sweeney, over Nagasaki. Weather was very poor, release being largely by radar, but once again, devastation was widespread.



NUCLEAR PROTOTYPES.—Finally released after 15 years are photographs of the atomic bombs which devastated Japan. Top is the "Little Boy" dropped over Hiroshima; it weighed 9,700 lb., was 120 in. long and 31.5 in. in diameter. Lower, is the Nagasaki "Fat Boy," weighing 10,000 lb., employing an annular implosion system of plutonium and measuring 128 in. by 60 in.

Sopwith Apprentices Celebrate

SOME 40 members and guests of the Sopwith Apprentices' Association gathered at the Royal Aero Club on December 7 for the Association's sixth reunion dinner. The speeches were humorous, nostalgic and in the case of MR. J. T. LIDBURY, joint managing director of Hawker Aircraft, concisely informative. He told us that the Hawker company had built 26,000 aeroplanes to date, including 1,000 Harts, 13,000 Hurricanes and 2,000 Hunters. Their prices had risen fantastically from £2,200 for a Hart (including £200/£300 for its Kestrel engine) to £7,500 for a Hurricane (Merlin £2,000), and £120,000 for a Hunter (Avon £20,000)—you might be able to buy a P.1127 for £250,000, he said to his listeners. A £200,000 annual turnover had become £25 million.


GEORGE BULMAN
Test Pilot at Farnborough and Hawkers 1919-1935
VIC DERRINGTON
Hon. Sec. & Sopwith seaplane specialist
SIR TOM SOPWITH
Founder of Sopwith Aviation, 1913
BILL WARNER
Aviation Consultant
DUNCAN DAVIES
Mr Sopwith's first apprentice
REG SUTTON
The evening's Chairman
JOE BEWSHER
an early Sopwith apprentice
he later worked for years at Vickers with
ERNIE COMFORT, another Sopwith apprentice, now working on the TSR.2
SIR FRANK SPRIGGS
who joined Sopwith Aviation in 1913
R.J. ASHFIELD
Designer of the Pup, Camel etc. and now with Fairey's
Sopwith Drawing Office, 1913

In a happy speech, SIR THOMAS SOPWITH, the Association's president, recalled a flight in the Tomtit with George Bulman, Hawker's chief test pilot for so many pre-war years. Sir Thomas, who hadn't then piloted an aeroplane for 16 years, took over in the air and intending to turn left, had instinctively pushed the rudder-bar in that direction as one would a bicycle's handlebars, and had of course turned to the right—"In no other contrivance do things work this way," he said (Sir Thomas, although a member of the Royal Yacht Squadron and remembered for his yacht *Endeavour's* attempts to win the America Cup, had obviously overlooked a rowing boat's rudder-lines).

Other speakers included A.V.M. L. T. Pankhurst, Wg. Cdr. W. W. Warner, Mr. J. H. Williams, Mr. Nat Somers and Mr. Thurstan James. Among the guests were Sir Roy Dobson, Mr. Peter Masefield, Sqn. Ldr. J. Severne, Mr. J. C. C. Taylor and Sir Thomas's son.—WREN.

Aviation News in General

FRENCH DETERRENT.—On Dec. 6 the French National Assembly endorsed a five-year programme to create an independent nuclear force. This includes the development of atomic and hydrogen bombs, the production of 50 Mirage 4 bombers, and missile research.

U.S. ORDERS.—The value of outstanding orders for aircraft, aero-engines and propellers in the U.S. was $12,463 million at Sept. 30 this year. This was 3% up on the figure for Sept. 30, 1959. Of the total, military orders represented 71% for aircraft, 80% for engines and 85% for propellers.

DECCA IN GERMANY.—Decca Type 41 weather radar has been installed at Frankfurt and Hamburg airports, and is to be installed also at Hanover, Munich and Schleswig.

ARGOSY NAVIGATION.—Marconi AD2300B Doppler Navigator and AD712 ADF have been selected for use in the Argosy C.1s for R.A.F. Transport Command. The Doppler order, which comprises sensor, computer and display unit, is worth £552,000 and the ADF order £100,000.

INTRUDER ORDER.—Grumman has received a $70 million order from the U.S. Navy for production of the Intruder low-level strike aircraft.

B-70 AIR DATA.—An order for development and manufacture of a central air data system for the B-70 has been reinstated. It is held by the AiResearch Manufacturing Division of the Garrett Corpn.

P.1127 STABILIZATION.—Sperry and the Smiths Group are collaborating to develop the automatic stabilization and flight instrumentation system for the Hawker P.1127.

B-70 WING.—Convair has been given a contract to produce a major part of the wing for the Mach-3 B-70 bomber. Brazed stainless-steel honeycomb panels will be used similar to those produced for the B-58.

NEW ELECTRONICS ASSOCIATION.—Ultra Electronics, Ltd., are purchasing a one-third share in Miles Electronics, Ltd. The two companies jointly designed and manufactured the Sea Vixen simulator equipment and are currently developing a simulator for the Buccaneer. Two Ultra directors, Mr. A. V. Edwards and Mr. L. R. Crawford, are joining the board of Miles Electronics.

FLEET TRIALS.—North American A3J-1 Vigilante Mach 2 all-weather attack bombers are expected in operational service with the U.S. Navy early next year. The aircraft's drooped leading edge slats, flaps and spoiler/deflector can be seen in this photograph of an A3J-1 being catapulted from U.S.S. "Saratoga"

C.A.C. IN TROUBLE.—The managing director of the Commonwealth Aircraft Corporation, Sir Lawrence Wackett, has said that the Corporation was in a very precarious position and was living from hand to mouth. Fifty skilled workers at its plant at Fisherman's Bend have recently been dismissed and many more people would have to go next year unless the Australian Government decided to build new aircraft for the R.A.A.F.

DOVE SALE.—Horizon Pictures (G.B.), Ltd., Associates of Columbia Pictures, have bought a D.H. Dove from R. K. Dundas, Ltd. The aircraft leaves the U.K. this week and will be used by Mr. Sam Spiegel, president of those companies, as his personal executive craft during filming of "Lawrence of Arabia" in the Middle East.

SUPER-POLARIS.—A second longer-range Polaris was successfully launched from Cape Canaveral on Dec. 5; it travelled 1,600 miles. New Polaris A-2, illustrated in our issue of Nov. 25, p. 703, is being developed to deliver a thermo-nuclear warhead over 1,725 miles, compared with 1,380 miles for the earlier A-1 version.

SWEDISH HAWKS.—In 1962 the Swedish Army is to be equipped with U.S.-manufactured Hawk AAMs. Range of the Hawk is reported to be 30 km. and its ceiling 18 km.

MULTIPLE SATELLITES.—A proposal to launch eight or 10 satellites from one carrier rocket is being studied by NASA. Each time a Centaur-boosted package attained apogee in an elliptical orbit, it would eject a satellite. Each satellite would have its own propulsion pack for converting it to a near-circular orbit. Technique is considered particularly valuable for establishing communication satellites.

GERMAN ROCKET.—The German Rocket Society is conducting research with small rockets. Of four rockets launched from a site near Cuxhaven recently, one is estimated to have reached an altitude of 10 miles. Research is aimed at producing a reliable vehicle for meteorological studies.

MOON CONFERENCE.—A symposium covering a wide field of lunar research, including map making, shape of the Moon, and origin of the craters, opened in Leningrad on Dec. 6. It was organized by the International Astronomic Union and the Soviet Academy of Sciences. British scientists attending included Prof. Z. Kopal and Mr. T. W. Rackham (Manchester University) and Dr. J. G. Davies and Dr. J. Ring (Jodrell Bank Experimental Station).

BELL FIGHTER.—A mock-up of the Bell D-188A Mach 2 V/STOL tactical fighter powered by eight General Electric J85-5 turbojets developing a total thrust of 25,600 lb. on take-off. The wing tip engine nacelles rotate from horizontal to 10° beyond vertical, the two aft engine inlets incorporate variable wedges and the fuselage is area-ruled. An operational evaluation aircraft could be produced in 18 to 20 months.

Commercial Aviation Affairs

FARES UP.—The new lower tourist fares on domestic routes which B.E.A. is to introduce next April will be higher by about 3½% than originally announced because of the recent increase in landing fees at British airports. All domestic fares will be affected by the increase except those to the Channel Islands and the Isle of Man. B.E.A. has estimated that the new landing fees will cost about £430,000 a year, of which nearly two-thirds will be attributable to domestic operations.

FARES DOWN.—As agreed at the recent IATA Traffic Conferences, B.O.A.C., in association with Qantas and M.E.A., will offer economy class excursion fares from London to Beirut, Cairo, Damascus and Amman from next February and to Tel Aviv from next May. These fares will be from £20 to £30 below the existing rates with further reductions for groups of travellers. The 14% reduction in transpacific economy class fares agreed by IATA has now been approved by the C.A.B. and became effective on Dec. 1.

GHANA'S IL-18s. — The Moscow newspaper *Sovietskaya Rossiya* reported last week that the first two Ilyushin Il-18s for Ghana Airways will be delivered soon. Russia will deliver the aircraft and associated equipment to Ghana and will help to train Ghanaian crews. Mr. Krobo Edusei, the Ghana Minister of Transport, said last week that Ghana Airways would obtain six Il-18s from Russia and planned to order two Boeing 720Bs also.

INDEPENDENT CLOSURES.—Three of Britain's smaller independent operators were reported to be in difficulties last week. Continental Air Transport, which had a fleet of two Vikings and a DC-4, is said to be in voluntary liquidation at Southend Airport, where the local council is taking steps to present a petition for the compulsory winding up of the company. Air Condor, which also operated from Southend Airport with two Bristol 170s and a Viking, is in the hands of a receiver and Orion Airways, with three Vikings at Gatwick, has ceased operation.

TITAN AIRWAYS.—This is reported to be the name of a new airline to be formed by Mr. Henry Corsellis with an initial fleet of two Vikings. Mr. Corsellis said last week that he may obtain personnel from Continental, Air Condor and Orion, all of which, as reported above, have recently ceased operation.

A.T.C. MISSION.—An eight-man team is visiting the U.S. for two weeks to confer with the F.A.A. on air traffic control problems. The group includes Air Chief Marshal Sir Hubert Patch (Air Ministry), A.V.M. Sir Laurence Sinclair (M.o.A.) and other members of the Planning Group set up by the Air Traffic Control Board. They will visit several U.S. airports to study F.A.A. traffic control facilities and will also see new equipment at NAFEC, Atlantic City.

B.O.A.C. CARGO PLANS.—Coinciding with the inauguration of transatlantic all-freight service with its two DC-7Fs, B.O.A.C. last week held a five-day training conference of sales representatives to discuss future cargo prospects. B.O.A.C. freighting has more than doubled in the past 10 years and figures so far available for 1960 indicate an increase of about 47% over the amount of freight carried by the Corporation last year.

CANADAIR DELIVERY. — On Dec. 2, Canadair delivered to Quebecair the first of two 52-seat Canadair 540 turboprop airliners. These two aircraft were converted to Eland power by Canadair and used by the R.C.A.F. during 1959 for crew training prior to delivery of the 10 Canadair CC-109s. Since August Quebecair has been operating another Canadair conversion, which is used as the company's demonstrator.

BOEING 727 DATA.—Further details of the Boeing 727 received after page 798 of this issue went to press reveal that it has a wing area of 1,650 sq. ft. and a cabin length of 72 ft. 2 in. The minimum turning radius is 79 ft. The ventral fin is located at the same point on the rear fuselage as the two side engines.

GOING TO GATWICK.—Alitalia, Iberia, Swissair and T.A.P. are expected to be the next airlines asked by the M.o.A. to transfer some of their Continental services from L.A.P. to Gatwick. A note on B.E.A. and Air France plans to use Gatwick appeared on page 757 of our previous issue.

ANOTHER VISCOUNT. — Vickers announced the sale of a Viscount 814 last week to the German charter operator Flugdienst. This Viscount, the 425th ordered, will be delivered next summer and is to the same standard as the nine Viscounts operated by Lufthansa, with which Flugdienst is associated.

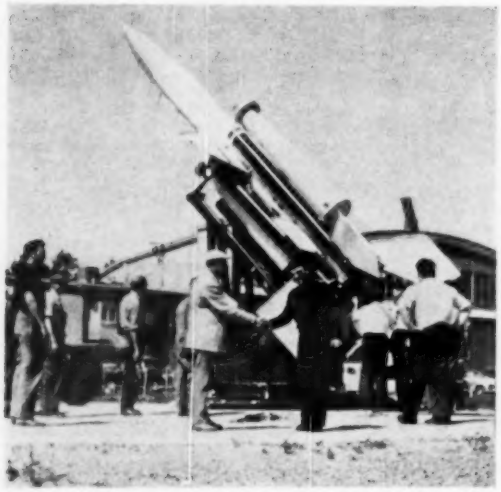
ICAO MEMBERS. — Three African states joined ICAO last week to bring total membership of this U.N agency to 83. The new members are the republics of Mali and Senegal and the Federation of Nigeria.

MANCHESTER EXTENSION.—Following complaints by B.O.A.C. about operational difficulties with the 707 (see last week's issue, p. 784) the Manchester Corporation Airport Committee has decided to lengthen Ringway's main runway from 7,000 ft. to 7,500 ft. and to give it a grooved anti-slip surface.

AIR FRANCE STRIKE.—Flight and cabin crews of Air France Boeing 707s went on strike on Dec. 10 in protest against proposed reductions in salaries following a cut in flying hours which had been recommended on medical grounds. Other Air France services were not affected.

News About People

CHIEF TEST PILOT.—Mr. Geoffrey Worrall has become chief test pilot of the Gloster Aircraft Co., following the transfer within the Hawker Siddeley Group of Wg. Cdr. R. F. Martin to the test pilot staff of A. V. Roe. Mr. Worrall was previously the company's chief production test pilot.



SWEDISH BLOODHOUNDS. — The first picture to be received from Sweden of an operational installation of a Bristol/Ferranti Bloodhound SAM of the R. Swedish A.F.S. Mr. V. A. Sutcliffe, leader of the Bristol Aircraft installation team, is seen shaking hands with Capt. J. Persson of the Swedish Air Force.

AIRMANSHIP COMMENDED. — A B.O.A.C. certificate of commendation for outstanding qualities of leadership and airmanship has been presented to Capt. Alfred S. Powell who was in command of the Britannia 102 which was landed at Khartoum on Nov. 11 with the undercarriage retracted because of hydraulic failure and "under conditions of considerable difficulty."

INVESTITURE.—A Livery Dinner was held by the Guild of Air Pilots and Air Navigators at Innholders' Hall on Dec. 7. The Master, Dr. K. G. Bergin, presided. The following were invested with the Livery: Wg. Cdr. J. E. Bazalgette, Lord Brabazon of Tara, Capt. E. B. Fielden, Gp. Capt. the Earl of Gosford, Mr. B. A. Loveridge, Mr. P. E. D. Moore, Mr. J. E. Rylands and Mr. M. A. Smith.

BLACKBURN ENGINES. — Lieut. Cdr. J. S. Sproule has become assistant sales representative of Blackburn Engines, Ltd., and is based on the company's London office. Before retiring from the Royal Navy in September, he was engaged on Service helicopter development.

Air Transport

Competing for the Short-haul Market

COMPETITION for a market which some estimates put as high as 1,000 aircraft over the next 10 years, grew more intense last week with the firming-up of production plans for the Boeing 727 and growing airline backing for the Vickers VC11. These two types, although not directly comparable, must now be regarded as the principal competition for the de Havilland 121 Trident, with the Boeing 720, Convair 880 variants, Caravelle variants, Comet 4 variants and East German VEB-152 all available to divide the market still further.

In the absence of detailed performance information on the Boeing 727 (see our previous issue and this issue page 798) it is difficult to compare this aircraft with the Trident, which outwardly it so strikingly resembles. It appears, however, to differ most in having a rather larger capacity and higher gross weight. The range of the 727 is also probably greater than that of the Trident 1, but the only figure given by Boeing, of 1,700 miles, is unrelated to payload or fuel reserves. With maximum payload and typical airline reserves, the Trident flies 700-1,150 naut. mile sectors depending on the fuel capacity. The 727 wing is swept back 32° compared with the Trident's 35°.

Insinuations were made in some sections of the British daily press last week that the 727 was in some way a crib of the Trident (the *Daily Mail*, for instance, stated flatly that it was "copied from British designs"). What, in fact, has happened is that Boeing have come up with almost exactly the same answer to a similar set of problems as did de Havilland three years ago; and as we showed in our Dec. 2 issue (page 733), Boeing could find no better location for three engines than the rear-fuselage arrangement. Acceptance of this layout by B.E.A. is now endorsed by two of the World's largest airlines.

The larger Vickers VC11, on the other hand, has the same four-engined layout as the VC10, and is, in effect, a scaled-down version of the latter (powered by Rolls-Royce RB163 Speys), just as the Boeing 720 is a scaled-down 707. It is with the Boeing 720, rather than 727, in fact, that the VC11 competes, with a gross weight of around 180,000 lb., a design range approaching 2,000 miles and accommodation for 140 passengers. Somewhere between the VC11 and Boeing 727 falls the proposed Trident 2, with greater capacity and range than the Trident 1.

Vickers confirmed last week that a major airline has taken an option on "fewer than 20" VC11s. This quantity, even allowing for likely re-orders from the same airline, does not yet justify a start on production of the VC11, but at least brings that point substantially nearer. British Aircraft Corporation salesmen are now vigorously "selling" the project around the World, with particularly good prospects of success in Australia.

Convair now appear to have dropped their Model 60 project, which was in the Trident/727/VC11 category, but have recently been offering the "Forty-Niner," a short-fuselage 880 capable of operation from 4,900-ft. field lengths. Douglas and Sud Aviation continue with their joint development of the Caravelle, but a recent statement by Mr. C. R. Smith, president of American Airlines, indicated this airline would not buy Caravelles, and with United and Eastern now committed to 727s, the possibility of Douglas obtaining enough U.S. orders to justify its production on the West Coast is receding.

One of the "fringe" projects in the short-haul category, the Hamburger HFB314, was withdrawn last week, the designers blaming lack of Government support. The Trident and 727 were now too far advanced, said Hamburger, to make construction of the HFB314 worth-while.

The spectrum of designs for the short-to-medium haul market therefore now looks something like this:

Over 1,000 miles: Vickers VC11, D.H. Trident 2 (and Comet 4C), Boeing 720, Convair Coronado.

500-1,500 miles: D.H. Trident 1, Boeing 727, Convair 880-M and "Forty-Niner," Caravelle 6 and 14, VEB-152.

Under 1,000 miles: BAC-107, Avro 771, Tu-124.

T.W.A. Financing

HOWARD HUGHES was reported last week finally to have given his sanction to the plan announced in October to finance T.W.A.'s jet equipment. The plan involves a loan of $168m. from insurance companies and commercial banks, raising $100m. by a new issue of debentures and a loan, if required, of $50m. from the Hughes Tool Co. Through the latter company, Howard Hughes owns 78% of the T.W.A. shares, and the insurance companies and banks insisted that these shares should be placed in their control through a voting trust as a condition of their making the loan. Hughes finally agreed to this condition only after exploring other possible plans.

T.W.A. can now be expected to go ahead with the purchase of 20 to 23 Convair 880s, many of which are complete and awaiting delivery. Six of the 30 originally ordered by Hughes have now been leased to Northeast (see page 797).

The Future of B.W.I.A.

A REPORT from Kingston, Jamaica, last week stated that the West Indies Federation has decided to take a majority shareholding in British West Indian Airways, which is at present a wholly owned subsidiary of B.O.A.C. Associated Companies.

This decision, if confirmed, presumably follows the report of the commission of inquiry which was set up by the Federal Government and which started work last July under the chairmanship of Sir Frederick Tymms. B.W.I.A. has been operating at a considerable loss year by year, but it is an important regional (and, more recently, long-haul) carrier and there has never been any doubt that the Federation wished to participate in the airline—if not to own it entirely.

B.W.I.A. links 18 widely scattered communities in the Caribbean area; operates long-haul services to New York and London; manages British Guiana Airways; and has British Honduras Airways (wholly owned) and Leeward Islands Air Transport Services (51%) as subsidiaries.

VANGUARD IN CANADA.—In company with a Viscount and a Douglas DC-8, the first Vickers Vanguard delivered to T.C.A. poses at Montreal after its arrival on Dec. 8. The "overhead-to-overhead" time for the three-sector flight from Wisley was 8 hr. 58 min. More details are on page 797.

B.O.A.C. East and West

INAUGURATION of Boeing 707 service across the Pacific by B.O.A.C. on Dec. 8 was a further important stage in the deployment of the Conway-engined transports by the Corporation, and opened a round-the-World service by pure jet airliner. The 707 service from London, via New York, San Francisco, Honolulu and Tokyo, links at Hong Kong with the east-about Comet service through Pakistan and India. The aircraft are arranged to carry 32 first-class and 97 economy-class passengers.

Two services a week are being flown each way between London and Hong Kong, with a third service on the trans-Pacific leg only from San Francisco. Total journey times are 36 hr. 45 min. from London (compared with 57 hr. 35 min. by Britannia) and 30 hr. 45 min. from Hong Kong (compared with 59 hr. 45 min.). A Japanese and a Hong Kong Chinese stewardess will be among the cabin crew of six on the trans-Pacific sectors, the remainder of the crew originating in London with each service and completing the round trip in 16 days with stop-overs in New York, Honolulu, Tokyo and Hong Kong.

Crews for the services originating and terminating at San Francisco also operate London-New York services and fly between New York and San Francisco by U.S. scheduled airline. Five captains are based permanently in Tokyo to assist with the Tokyo-Hong Kong leg, where specialized knowledge of the approaches to Hong Kong is necessary to assure regularity in poor weather.

Additional B.O.A.C. services to the eastern U.S. seaboard will be permitted if the C.A.B. confirms the opinion of its chief examiner, Francis Brown. He recommended last week that B.O.A.C. should be allowed to serve Washington-Philadelphia and Boston as terminals on Atlantic flights, and that Boston should also become a terminal instead of an intermediate point on services to New York.

B.O.A.C. will extend its 707 services eastwards on Jan. 30, serving Teheran, via Geneva and Tel Aviv, on two round trips a week. At Teheran, the 707 will link with Comet services to the Far East and Australia, while in London it will connect with the 707 Monarch service to the U.S. Total journey time will be 10 hr. 10 min. outward and 11 hr. 25 min. inward, with accommodation for 52 first-class and 63 tourist-class passengers.

A Fourth Moscow Airport—Domodedovo

A REPORT on progress at the new Moscow airport of Domodedovo appeared in *Pravda* of Nov. 26, 1960. The main runway of this new airport, which will be able to take aircraft of all types (the Tu-104 and Tu-114 are mentioned), is almost complete and training flights will soon be started by Aeroflot crews.

At the present time the area looks ideal for an airport, but, before work began near the small village of Domodedovo, there were many natural features such as hills and valleys which have all been levelled. The situation is ideal, as the approach area and circuit are quite clear of Bykhovo, Vnukovo and Sheremetievo, the other three Moscow civil airports. The new airport will be one of the largest in the World when completed.

There will be a very large hangar which will accommodate four Tu-114s or about 10 Tu-104s together. The main structure of this hangar is nearly complete and work is now beginning on the smaller servicing buildings attached to it. Work on the site has been held up a little by the early snow, but most of the work of levelling off the soil over water pipes and cables has been done and grass seed has been sown in a number of places. The whole airport has been designed with an eye to the future development of air transport in the seven-year plan and the handling capacity will be for several thousand passengers per hour.

The work on the main building is only just beginning. The specialists of Aeroproject have designed a comfortable but light and beautiful structure. A wide motor road approach leads up to it. The two "fingers" will have stands for 14 aircraft. Attention is being given to the installation of radio and wide-screen television in the waiting rooms and there will be special lighted arrival and departure indicators.

Transport to and from the city will be by helicopter, motor-bus and electric train. The new road and railway are now being laid down and for the future the engineers are planning a high-speed overhead monorail system. Much has yet to be done before regular services will start to use Domodedovo, but the work is going ahead rapidly.—F.J.F

Air Transport . . . .

Competition for Cyprus

THE present contract by which B.E.A. operates the services of Cyprus Airways comes to an end on Dec. 31. The Cyprus authorities have meanwhile asked British United Airways to make a bid to operate the island's air services—an action which makes good commercial sense and which is rarely possible in the airline business.

By inviting a rival bid, the Government of Cyprus will be better able to assess the long-term value of the airline's services and traffic rights. It is more than likely that the contract with B.E.A. will be renewed—but competition of this kind between two hard-headed businesses can do nothing but good. Cyprus Airways' services are between Nicosia and Istanbul, Ankara, Beirut, Tel-Aviv and points in the Middle East area. B.E.A. has a 22.7% holding in the company.

SHORT-PITCH SEATING

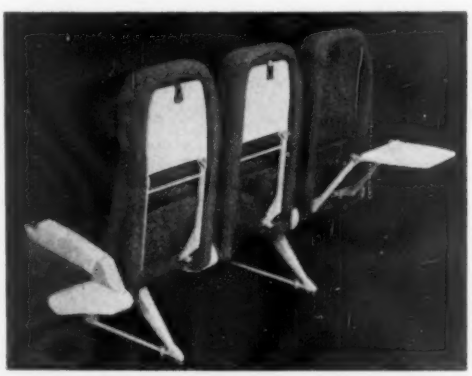
A NEW range of lightweight aircraft seats designed to meet the requirements of economy and Sky-coach services is now being produced by Aircraft Furnishing, Ltd. Known as the Lonsdale 300 Universal Flyweight and the third in the series of seats to be developed by this four-year-old company, it has to date been ordered for use in B.O.A.C. Britannias and the Friendships of New Zealand National Airways.

Following the earlier Lonsdale seats—the T.34 fitted in B.O.A.C. Britannias, B.E.A. Viscount 701s and Comet 4Bs, and the Lonsdale 200 series in service with several Comet fleets—the Universal Flyweight incorporates a number of progressive design developments. With fixed or reclining backs, tip-up seats and tables, it has 15-in. leg clearance for the comfort of the occupant of the seat behind even at the short pitch of 28 in.

Of tubular construction, the Flyweight is available in two- or three-seat units built around a single high tensile steel monospar. This allows any energy created in a fore-and-aft direction to be absorbed in the monospar which acts as a torque tube. The legs are bolted to the monospar and are adjustable laterally so that the seat unit can be fitted to a wide variety of current transport types.

All coverings are easily removed and the usual provision is made for the storage of a life-jacket under the seat. Intermediate arm rests fold up between seat backs, which house the tip-up trays when not required. Fully equipped, including tables, safety belts, ashtrays, life-jacket stowages and magazine pockets with forward facing reclining backs, the triple-seat unit weighs 56½ lb. The similar double-seat unit weighs 39½ lb., while the double fixed-back seat totals 36½ lb.

The Flyweight meets both A.R.B. requirements and F.A.A. specifications, and saves 45% on the price of the earlier Lonsdale 200 series.



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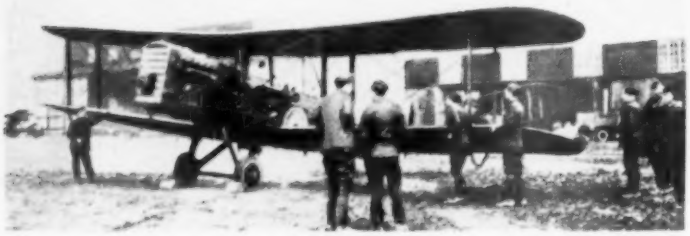
Squadrons of today's Royal Air Force—No. 2 of a series



D.H.9A at Cologne, 1918

From across-the-Rhine bombing to around-the-world transport

99 Squadron has had three lives. It was formed as a strategic bomber squadron of the Royal Flying Corps in August, 1917. The gallantry of the daylight raids into Germany in 1918 was eventually commemorated in the squadron motto 'Quisque tenax'—'Each one tenacious.' Disbanded in 1920, the squadron re-formed in 1924 as a night bomber squadron.

Based in India for most of the war, the squadron, operating with Wellingtons and later with Liberators, carried out many successful attacks on Japanese-held bases. 99 became noted for the accuracy and regularity of its bridge-busting on the Burma-Siam railway.

When the Japanese retreated they left many British prisoners-of-war in Rangoon jail. 99 Squadron successfully dropped supplies into the jail itself—a tricky job which, in a way, foreshadowed the squadron's next role. In 1947 the squadron re-formed at Lyneham, this time as a long range transport squadron. And in 1959, 99 Squadron took delivery of the first military version of the Britannia which carried a payload of over 15 tons.

99's first aircraft—the D.H.9—carried one 230 lb. bomb.

Britannia over Kilimanjaro, 1960

36-year-old Wing Commander W. E. F. Gray, *educated at Ottery St. Mary Grammar School, joined the R.A.F. in 1942. After training in Saskatchewan under the Empire Training Scheme he became an instructor on Ansons; after this his instructing duties ranged from Tiger Moths to Lancasters. 1948 saw his first experience of a Transport Command squadron—with 216 in the Middle East. In 1952 he spent a year as Squadron Leader (Training) at the Central Flying School. Then followed a 3-year tour in the Directorate of Flying Training and two years on Transport Command Examining Unit. He became a Flight Commander in 99 Squadron in 1958 and took over command of the Squadron in October, 1959. He has logged 200,000 miles in the Britannia to date. His comment on the aircraft is to the point,—'No vices'. He is married and, when he finds the time, likes to go fishing or rough-shooting.*

27-year-old Flight Lieutenant Keith Shorrock *has been navigating on world routes since he was 20 and has logged well over 400,000 miles. Educated at King George V School, Southport, he joined the R.A.F. in 1951. After training he joined 84 Squadron in Fayid, Egypt, and was on detachment to Cyprus in 1956. Did a round-the-world trip in 1958 via Australia, Christmas Island and U.S.A. Has also flown to Barcelona, Nairobi, Gold Coast, Canada, Fiji, Honolulu. Looking forward to flying on the Singapore-Hong Kong run. Single, he lives on the station at Lyneham where he runs the sailing club. (He sails a Firefly dinghy and recently crewed in the R.A.F. sailing championships). Likes fell-walking in the Lake District.*

26-year-old Flight Lieutenant Dave Ray *never had any doubts about the career he wanted. Starting in the A.T.C. at 16, he joined the R.A.F. in 1951 as soon as he was 17½. After advanced flying training he went on to Vampires and joined 16 Squadron in Germany. Then, in 1957, he converted to Canberras and joined 69 Squadron which moved to Malta in 1958. Came to 99 Squadron in 1959 as a Britannia co-pilot and has already logged over 90,000 miles. Thinks the Britannia is 'beautiful to fly' but also likes to keep his hand in at gliding at the R.A.F. club nearby. He expects to be an aircraft captain within a year and hopes to be posted abroad. His wife is keen to go, too; no comment from his 1-year-old daughter.*

37-year-old Squadron Leader E. H. Burgess—*always called Pat, despite his initials, because he was born on St. Patrick's Day—is the doyen of the squadron's navigators. Joined the R.A.F. in 1942, commissioned in 1943 with 78 Squadron, Bomber Command, and awarded the D.F.C. after 32 Halifax raids over Germany. Joined 96 Squadron in 1945 on supply-dropping to the 14th Army. The offer of a permanent commission in 1946 changed his mind about becoming a science master. Promoted to Squadron Leader in 1954 while in the Middle East with 78 Squadron again. Joined 99 Squadron, after a period at Staff College, in 1958. His scientific background came in useful in helping to devise techniques for using Britannias economically. He recently flew to Cape Verde Islands; he recommends the local wine which is cheaper than beer. Keeps fit with Scottish dancing and keen, inaccurate tennis. Married, with two daughters.*

The R.A.F. still needs men like these

The Britannias of 99 Squadron don't waste any time. When they take off they go up at an angle of climb that means business. The business is long range support of our overseas forces. This covers a huge range of activities.

To begin with there are the flights in support of the V-bomber force which have earned Transport Command the description of 'the other half of the deterrent'. Again, the Squadron could be called on 'fire brigade' duty, that is to transport fully equipped troops to a danger spot. Then there are the 'milk runs'—the routine flights carrying passengers and freight to stations extending around the globe. Finally there are special runs—flying out urgently needed equipment, or perhaps on aero-medical evacuation (there are plug-in points for iron lungs from the Britannia's own oxygen supply).

Maintaining 'the other half of the deterrent' obviously calls for men who can take responsibility. It is no exaggeration to say that the captain of a Britannia has one of the most responsible jobs in the world. His own particular skill must be beyond question and he must also be able to get the best out of his crew. He is solely responsible for the safety of his passengers and his freight, not to mention a £1½ million aircraft. He must be familiar with world routes—weather conditions, the characteristics of different airfields, maintenance facilities. He has to be aware of political conditions in the countries he flies over or to, and must sometimes have the gloved touch of the diplomat. Airman, leader, technician, the captain is all these, and he certainly earns his very good pay.

During the next five years Transport Command will double its operations and the demand for aircrew will increase in proportion. Pilots are now being accepted for training direct from R.A.F. Flying Schools and these men have every chance of becoming captains of their own aircraft within four years.

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You will be sent full details of the latest pay and career structure, together with an illustrated booklet. This contains the addresses of the R.A.F. Careers Information Centres where you can call in if you would like to talk things over.

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Air Transport . . . .

Vanguard to Canada

TRANS CANADA AIR LINES' first Vickers Vanguard 952, CF-TKO, left Wisley on Dec. 7 on its delivery flight to Montreal, where it arrived on Dec. 8 after stops at Keflavik and Goose. Total flying time for the journey was 9 hr. 34 min. The three sectors were flown at cruising T.A.S. of up to 440 m.p.h., giving an average ground speed of about 390 m.p.h.

In command of this delivery flight was Capt. George Loth an, T.C.A. superintendent of flying, who was the company's first pilot to convert to turboprops in 1954. He was accompanied by Vickers' test pilot Dick Rymer, who, as a B.E.A. captain, was the first airline pilot in the World to obtain a turbine endorsement on a commercial licence. Another historical s delight of the Vanguard delivery was that it was made six years to the day after T.C.A. took delivery of the first of 51 Viscounts. On these Viscounts and 23 Vanguards, T.C.A. has expended to date some $121 million, believed to make the airline Britain's largest single dollar customer.

Four T.C.A. captains have been training on the Vanguard at Wisley, but the bulk of crew conversions will be done at Montreal. Scheduled service with the Vanguard is now expected to start on Feb. 1, on the daily transcontinental flight linking Montreal, Toronto, Winnipeg, Regina, Calgary and Vancouver, and on the Toronto-Vancouver flight calling at Winnipeg, Saskatoon and Edmonton.

Other routes will be added steadily to the Vanguard's tasks from then until July. It is expected to be seen in the U.S. for the first time by the end of April, on the Toronto-Chicago route, and will be going on to New York from Montreal by the middle of May.

An Argosy Delivered

RIDDLE AIRLINES was taking delivery of its first Armstrong Whitworth Argosy at Coventry last week-end and planned to fly it to Miami for intensive crew training. The Argosy at present has a restricted British and F.A.A. certificate of airworthiness for demonstration and familiarization flying, and obtaining the full U.S. certificate for cargo flying will be an early priority. The delivery flight was being made by a Riddle crew accompanied by A.W.A. test pilot George Simpson, who will remain in Miami to assist in crew training.

One of the problems which remains to be sorted out is whether the F.A.A. will clear the Argosy for two-crew operation for which it is basically designed. Present regulations require a crew of three on aircraft with a gross weight of more than 80,000 lb. (the Argosy weighs 82,000 lb.), but a concession might be obtained for Riddle's all-freight operation. In any case, the Argosies for Riddle have been modified for optional two- or three-crew operation and have two additional jump seats on the flight deck.

Other modifications include the installation of a flight recorder and high intensity anti-collision lights; fuel jettisoning provision; fireproofing of the cargo hold and an upward escape hatch in the rear of the hold.

Riddle intends to aim for an annual utilization of 4,200 hr. each for its seven Argosies, the last of which will be delivered before the end of April, 1961. This is a very high target, especially for an aircraft in its first operational use, and is likely to take a year or two to achieve.

The Argosies will be used by Riddle primarily for the Logair contract, which calls for the daily operation of three services from Tinker Air Force Base, Oklahoma, to other bases, carrying items of "outsize cargo." The total commitment is for more than 4½ million miles a year and, assuming the contract is renewed for 1961/62 and 1962/63, Riddle expects the Logair flying to produce a total revenue of $25 million. The contract was won on a bid based on an aircraft-mile cost of $1.65. The cost of the aircraft to Riddle has been reported to be about $1.31 million each, the total contract, including spares, being worth some $12 million.

N.Y.A.'s NEWEST.—Now finished in New York Airways colours, the prototype Boeing-Vertol 107-II is seen here at the 30th Street Heliport in Manhattan, where the type will be seen regularly from next April. N.Y.A. have applied for permission to operate an hourly helicopter service between Manhattan and the new Philadelphia heliport on the Delaware River, opened last week.

Comet Utilization

DE HAVILLAND COMETS have now completed two years of operational service, and some information was given recently by the makers about utilizations achieved by the user-airlines. There are now 36 Comet movements a day at London Airport, and eight airlines are flying about 137,000 route miles a week with Comets.

B.O.A.C., which has had its fleet of 19 Comets complete since January of this year, is now averaging some 10½ hr. a day per aircraft, and Aerolineas Argentinas, using four Comets, is averaging 9½ hr. a day. The overhaul interval on the latter's Comets has recently been increased.

Mexicana, with its first two aircraft, is achieving more than 8 hr. a day, and East African is exceeding 7 hr. a day with its first two Comets. United Arab Airlines, also with two Comets delivered, recently maintained their Cairo-London service for 12 days with one aircraft, averaging nearly 11 hr. a day. A similar record was established last summer by a single B.O.A.C. Comet which made ten round trips from London to New York in 11 consecutive days.

B.E.A., using Comet 4Bs on short-stage operations (one landing every 1.7 flying hours, compared with a B.O.A.C. figure of 3.5) have averaged 6.4 hr. a day per aircraft, and this figure is still increasing. Olympic Airways utilization is similar.

The last airline to introduce Comet service, of the present customers for the type, will be Middle East Airlines. Since November, B.O.A.C. Comets have been chartered to fly M.E.A. services in partial M.E.A. livery, and the first of M.E.A.'s own Comets flew for the first time at Hatfield on Dec. 3.

NORTHEAST JET.—As recorded last week, Howard Hughes has released six of the 30 Convair 880s ordered for T.W.A., to allow them to be leased by General Dynamics to Northeast Airlines. The first two were to go into service on the Boston-Philadelphia-Miami route on Dec. 15.

More About the 727

Boeing Airplane Co. last week announced orders worth over $350 million for the Boeing 727 short-haul jet transports.

ADDITIONAL details of the Boeing 727 short-haul jet transport, briefly described in our previous issue, have been given by the makers, but performance data at this stage are being indicated in only the broadest of terms. The 727 has been designed for "use on flights with many stops, serving airports where much of the World's commerce begins and ends."

The choice of cabin width was dictated by tourist-class earning potential, as well as the fundamental design objective of using 707-720 tooling wherever possible. Both these considerations indicated a fuselage having the same diameter as that of the 720, sufficient to allow comfortable six-abreast seating. Compared with a diameter sufficient for only five-abreast seats, this fuselage increases aircraft-mile operating costs by less than 1% but increases the maximum revenue by 12%, Boeing claim. Aircraft-mile costs of the 727 on a 500-mile sector are about $1.50, and in tourist configuration the direct operating costs per seat-mile are more than 10% below those of the "latest American turboprop airliner."

Design studies on a short-haul transport began at Boeing early in 1957, when the company had become convinced that a whole family of jet designs was needed to meet the requirements of the World's airlines—a philosophy which has been the cornerstone of Boeing's subsequent success in selling 337 jets to 21 airlines. In 4½ years, 150 different designs have been analysed in detail and 68 of these underwent a total of 1,500 hours of wind tunnel testing.

Most of the early studies were of twin-engined aircraft. Boeing have mentioned, for instance, the 727-257, with engine pods on struts above and behind the wing, the 727-265 with two conventional underwing pods, and the 727-264C with pods on the rear fuselage. Studies of these and other twin-engined projects in relation to all major U.S. domestic airlines' routes tended to underline the operational limitations of the twin-engined layout. As an example of the problem, limitations for operating a twin are likely to cause delays of more than an hour on 342 occasions per year at Idlewild.

By comparison with this statistic, a three-engined design would be delayed only 115 times. Before the three-engined layout was adopted, however, four-engined versions were studied, including the 727-475 or "720 Junior" with conventional wing pods and the 727-474 with rear-fuselage pods. The direct operating costs of both twin- and four-engined types were found to be higher than for three-engined designs. A survey of possible customers and investigation of available powerplants for the 727 showed no reasons for abandoning the triplex type, and continuing analysis of the latter against a twin showed better range, equal or better operating costs and superior operational flexibility and reliability.

On Jne. 1, 1959, the 727 was initiated as a full-scale project under Jack Steiner, chief project engineer. Studies were made of many possible triplex layouts—three engines around a vee-tail, three engines around a twin tail, two wing pods and one engine in the tail and three wing pods (two one side and one the other)—before the final arrangement was chosen. Among the advantages of this arrangement claimed by Boeing are the ability to run the centre engine for cabin conditioning and electrical power with the aircraft on the ground; the wing left clear for high lift devices and elimination of yawing tendencies with one engine failed.

Boeing expect to fly a prototype 727 within 15 months and to begin deliveries to Eastern and United in late 1963. Both the first flight date and first delivery date are about six months behind those for the D.H.121 Trident. The provisional B.E.A. order for the latter was placed in February, 1958, and a firm contract was signed in August, 1959.

Both Eastern and United have ordered 40 Boeing 727s, although half the United order will only become firm when "the Capital Airlines-United Airlines merger is consummated, or upon achievement by United of certain projected financial ratios." Total value of the two orders is more than $350 million. Both will use the 727 to replace piston-engined equipment.

The 727 is designed to carry from 70 to 114 passengers. From an early stage in the design Boeing was attempting to meet United's specific requirements, with Eastern coming into the picture later. For both these airlines and other U.S. domestic operators, good field performance was a critical factor (see "Talking Shop at Seattle," our issue for Dec. 2, p. 733) and Boeing claim that the 727 will have take-off performance "superior to all jets in its class. At equal gross weights, it will require less C.A.R. field length for take-off than the most modern turboprop-powered aeroplane made in America."

The gross weight of 142,000 lb. is rather more than was being discussed for the 727 a year ago, when it was a 128,000-lb. project with three ARB-963 (Allison-built Rolls-Royce RB.163 Spey) engines. Use of these engines, favoured by Boeing, was resisted by the customers, leading to a revision of the design to have the more powerful Pratt & Whitney JT8D-1s. This engine is the turbofan version of the J52, which is in production as the powerplant of the Grumman A2F-1 Intruder and the North American Hound Dog missile.

Engineering Details

Boeing have provided the following brief description of the 727 structure and systems.

"The primary wing structure is of aluminium alloy skin stiffened by stringers. As in the Boeing 707 series, the wing is an aeroelastic structure, giving a smoother ride through turbulent air. The two wing spars serve to carry shear loads, while skin and stringers carry the major portion of the bending loads. The inter-spar volume of the wing is sealed to provide integral fuel tanks. Fuel lines from tanks to engines run outside the fuselage wall at cabin floor level and are covered and protected by a streamlined fairing.

"The fuselage is of semi-monocoque construction consisting of "Z"-type frames and hat-type stiffeners. Window spacing and size is the same as that found in the Boeing 720. Each window is triple-paned, with two pressure panes and a light plastic inner pane.

"Basic 707 tooling is used in construction of the upper lobe of the 727 fuselage, including the cockpit.

"Low-speed performance is built into the wing by means of advanced high-lift devices. These consist of triple-slotted trailing-edge flaps and leading-edge flaps and slats. The slats, installed on a Boeing jet for the first time since the XB-47 Stratojet, are of advanced design and extend forward and down from the upper leading edge of the wing at low speeds, forming a slot. The leading-edge flaps, inboard of the slats, are similar to those found on the Boeing 720.

"With low-speed devices retracted, the 727 wing has the same ratio of span to thickness as the Boeing 707.

"The vertical fin of the 727 is surmounted by the variable incidence horizontal stabilizer and the elevators to give greatest low-speed effectiveness. At the body attachment point, the vertical fin is 40 in. thick. It is a two-spar structure equal in strength to the wing.

"The tail fin and rudder are swept sharply aft to give the control surfaces maximum effect for minimum size and weight. A ventral fin is fitted to provide a positive indication of the maximum rotation of the aeroplane for the shortest take off distance. [This fin is not shown in the released illustrations of the 727.—ED.]

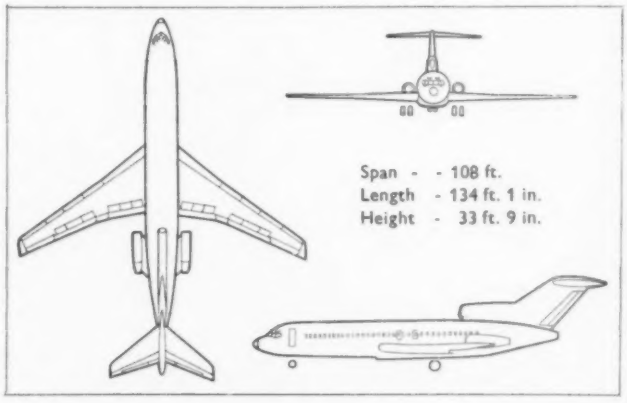
"The 727 uses aerodynamic actuation in the elevator and aileron controls, with dual hydraulic power packages assisting with control surface movement at all ranges of travel. The rudder is controlled through dual hydraulic power packages. The aeroplane can be controlled manually, with no assistance from the hydraulic system.

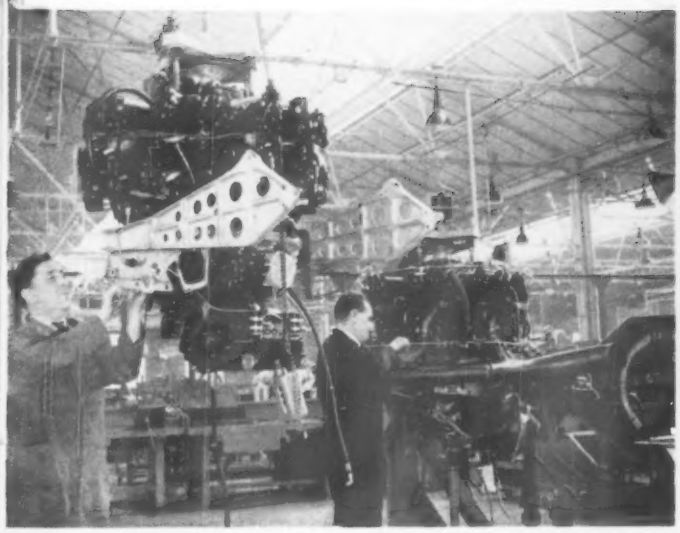
"Principal systems in the 727 are similar to those of the Boeing 707 series with identical equipment being used wherever possible.

"Electrical power is alternating current for the most part, with direct current provided through transformer-rectifiers to power certain equipment.

"Dual air cycle air-conditioning is used, as it is in the Boeing 707 and 720 series, with pressurized air being bled from the engines.

"The hydraulic system, made up of two non-interconnected systems, provides power for flap operation, landing gear extension and retraction, wheel braking, nosewheel steering, operation of rudder, spoilers, ailerons and elevators and extension and retraction of passenger stairways at the rear of the fuselage and under the forward passenger entry door."





Above, Leonides Majors being assembled as engine change units.

Alvis Activity

Among the facilities at the Alvis factory at Coventry is a large section specially laid out for the repair and overhaul of Leonides and Leonides Major powerplants for fixed- and rotary-wing aircraft. This section deals with some 40 engines per month.

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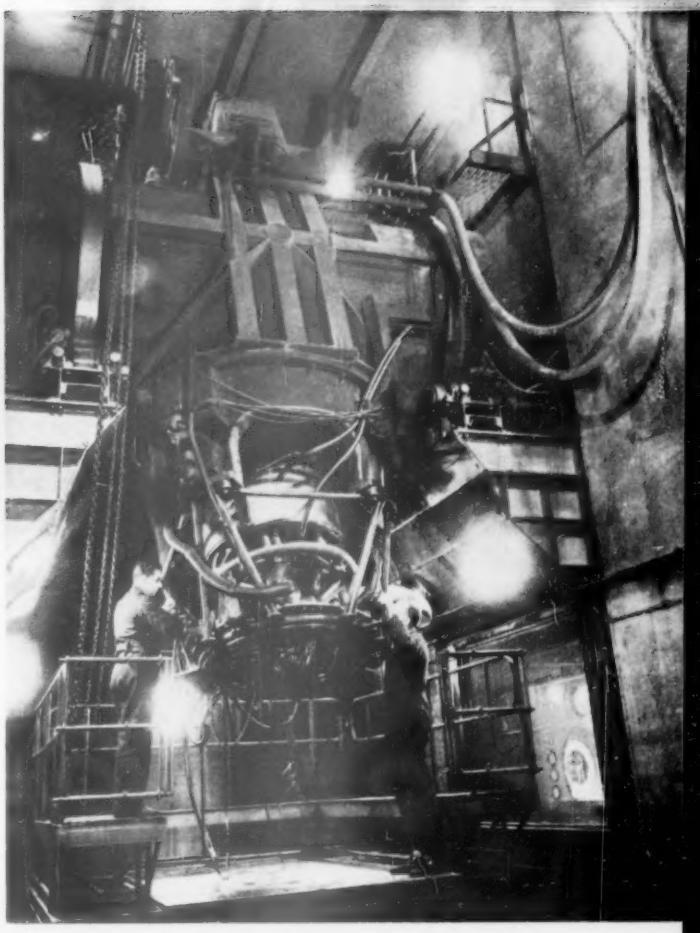
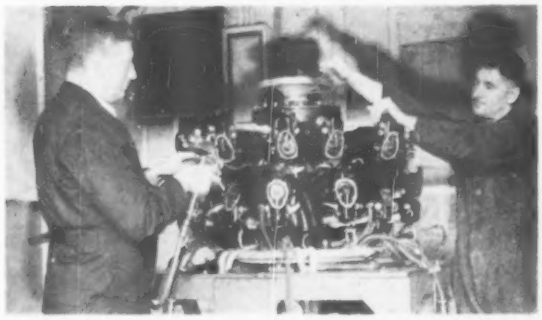


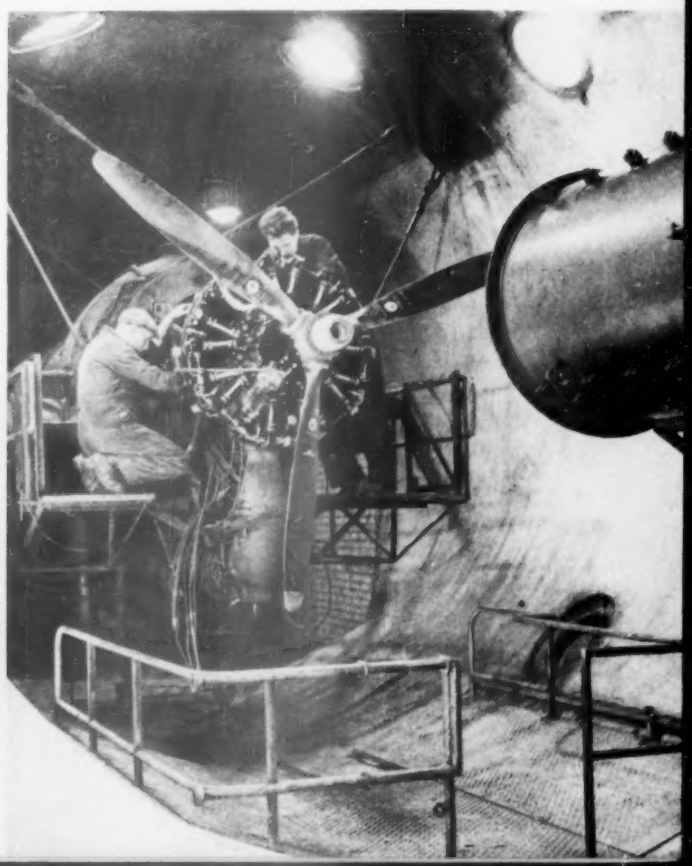
Above, helicopter-type Leonides and Leonides Majors are run in this special test-bed which has a rotatable mounting for giving the required powerplant angle.

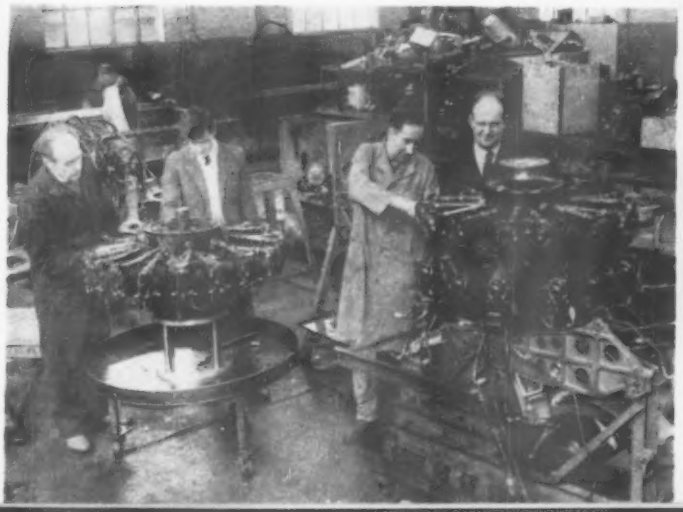


Above, an engine being inhibited before being sent to the despatch section.

Right, installation of an aircraft-type Leonides in the hangar-type test-bed.

Below, Leonides and Leonides Majors being stripped prior to overhaul.





Flying the Morava L.200A

by

John Fricker

IN light aircraft production, Czechoslovakia is probably second only to the United States, although the gap in relative output is naturally fairly large. Most Czech sales are within Eastern Europe, the Soviet Union being the biggest customer.

More than half the total production of some 120 five-seat Morava L.200s built so far by the First Five-Year Plan Machine Works at Kunovice has gone to Russia, since the prototype first flew on Apr. 8, 1957. Now being produced is the L.200A, with a modified fuselage and the supercharged M-337 inverted-six units developing 210 b.h.p. for take-off, with fuel injection, in place of the original 160 b.h.p. Walter Minor 6-IIIs. Their installation adds some 20 m.p.h. in cruising speed and a corresponding improvement in all-round performance.

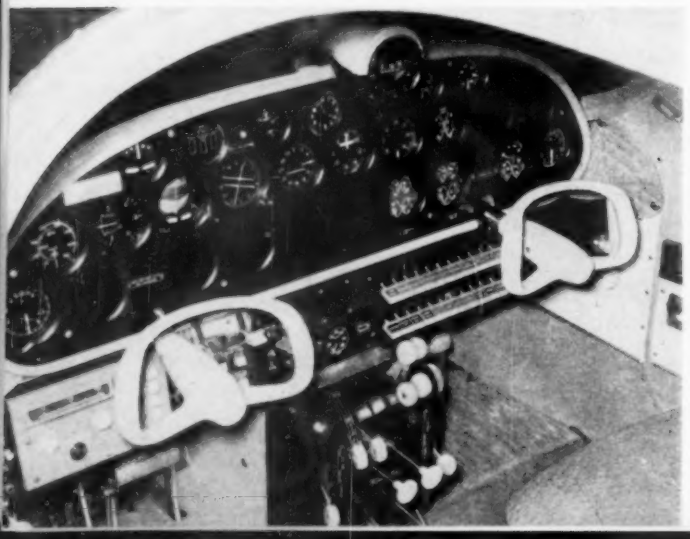
Modifications on the visiting L.200A, OK-OHA, at Southend included relocation of the exhaust ejector tubes to port of the nacelles, which have been extended to the trailing-edge of the slotted flaps. A lower forward cabin roof gives more slope to the front screen, and a large wing-root fillet has been added. Hydraulics have also replaced electrics for undercarriage and flap operation.

Construction is entirely of metal, including the control surfaces, the double-skinned wing leading-edge for thermal de-icing, and the fixed wing-tip tanks. These have a capacity of 25 Imp. gal. per side, and are augmented by auxiliary cells, all with booster pumps, in the outer wings of 21 gal. per side, bringing total fuel to 92 gal. (less than one gallon unusable). Full tanks permit four occupants and 100 lb. of baggage to be carried.

Front seats in the spacious cabin are adjustable for leg reach. A small shelf above the rear bench seat holds up to 66 lb. of light luggage, and behind it is the ground-accessible main baggage compartment of up to 264 lb. capacity.

Although the twin entrance doors to the cabin are convenient, their size and their apertures are presumably responsible for their massive frames and that of the front screen. The result is an indifferent forward view, because of thick structural members and vision to the side obstructed by the engine nacelles.

An opening clear-vision panel also adds its quota of obstruction to forward visibility, plus the sharply raked front screen with its wiper arm parked outboard of the wide centre strut, and the rather high instrument panel. This comes well above the nose coaming line, but allows plenty of room for instruments and radio. Bottom left is the Czech VHF comm. radio, with a Russian radio-compass as an additional aid, but space is available in the centre for nav. radio.



Press-button magneto, starter and airscrew controls are visible on the lower panel of the Morava L.200A.

Instrument layout is fairly conventional, with a full metric flight panel to port, and engine references to starboard, with space to spare. Engine boost and revs. indication is by superimposed needles on the two instruments, American fashion. Power controls are on a central console, convenient to both front seats, which also have full dual (except for single toe-brakes), including elegant moulded handwheels on straight push-pull shafts.

Airscrew, starter and magneto controls are push buttons as in the Aero 145 (our issue of Jne. 17), although the Morava also had conventional pitch levers in readiness for constant-speed propellers. Three rows of buttons are arranged vertically, for the electrically variable V-410A airscrews. Centre are the master switches for combined selection of take-off (18°), climb (20°) and cruise (27°) settings. Flanking these are twin buttons for coarsening or fining off the pitch of each propeller for synchronization, with feathering buttons under plastic covers above them.

This system is effective, although perhaps unnecessarily complicated. It seems, in any case, that the Morava will go back to the time-honoured levers with its constant-speed airscrews. A prototype installation of these is already flying, but the press-button mag.-switches and starter buttons will presumably remain unchanged.

For starting, the centrifugal superchargers of the M-337 engines must be engaged via two long levers among their numerous fellows at the bottom of the central console. The superchargers have a five-minute limit at full power below 5,000 ft., but their use is otherwise unrestricted. The M-332 engines have a sporty rumble, mostly emanating from the starboard exhaust augmenter tube, inboard of the nacelle.

Like most of its American contemporaries, the Morava has a steerable nosewheel from the rudder pedals through 30 degrees each side, plus a free-castor from braking or differential power action. Ground manœuvrability, however, proved disappointing because of poor brake action and imprecise steering.

The hydraulic brakes appeared to need bleeding and the nosewheel demanded unprecedentedly high pressure (I estimated at least 100 lb.) on the close-set rudder pedals, before response was forthcoming. I thought something was unserviceable, but Mr. Skala in the right-hand seat explained that the actuation ratio had been altered following nosewheel shimmy.

Elevator and rudder trim-wheels, between the front seats, were set to zero before take-off, having warning lights for their neutral points. The take-off pitch button was selected and 15 degrees of slotted flap lowered via the appropriately shaped handle on the panel.

Flaps and undercarriage have an hydraulic stand-by lever between the seats, the flaps being infinitely variable up to 30 degrees on the dashboard dial. The lever must always be returned to neutral, however, otherwise actuation appears to continue over centre.

With four-up and about half-fuel, take-off acceleration was

brisk, at full supercharged power of 880 mm. (34.5 in.) Hg. and 2,750 r.p.m. Because of the steering coupling, foot pressure to correct a swing to port was strong, and remained high during rotation at 60-70 km./hr. (37-43 m.p.h.) and unstick at 100 km./hr. (62 m.p.h.) I.A.S. These figures seemed to indicate a good low-speed performance, although the safety speed is considerably higher at 138 km./hr. (86 m.p.h.), suggesting inadequate directional surface area. Cross-wind limit for take-off is 15.5 m.p.h.

Undercarriage and flap retraction both result in a slight nose-up tendency, which helps to establish the very steep climb attitude at 170 km./hr. (105 m.p.h.). An en-route climb at a high speed would be rather more comfortable, and would also permit some forward view which is just not apparent through the front screen at the lower figure. With four up, the V.S.I. indicated a healthy 6 m./sec. (1,180 ft./min.) during the climb-out at 740 mm. (30 in.) Hg. and 2,600 r.p.m., at which supercharging is unlimited.

For cruising, power is reduced to 660 mm. (25.9 in.) Hg. and 2,400 r.p.m. by another touch of the pitch button, after selecting boost with the throttles, and the engine noise becomes rather more acceptable, although still resonant. I cruised around North Essex at about 4,000 ft. in surprisingly good weather, indicating about 265 km./hr. (164.6 m.p.h.) at a slightly lower setting than that recommended. Use of the supercharger adds about 10 km./hr. to the cruising speed, and puts up the fuel consumption by about 10%.

The L.200A proved quite pleasant to handle, the responsive ailerons demanding the usual amount of effort associated with tip-stowed fuel. In contrast, the elevators were rather lighter than average, with a low stick force per *g* for the +3.5 and −1.5 (B.C.A.R. Normal, Group D, and C.A.R. Part 3, Normal) structure. Rudder forces were well harmonized, except under certain asymmetric conditions.

The Morava is an attractive-looking aeroplane, although this view shows how the engine nacelles restrict pilot visibility downward and to the side.

Laterally, the Morava proved neutrally stable, like most aircraft of its class, and it was just about positively stable, longitudinally. Directionally, it again showed some deficiency in vertical surface area. Rudder trim tab area also seems inadequate despite aft extension subsequent to the prototype.

With the present airscrews, feathering takes about 15 seconds, but the yaw in cruising flight is small, and can be cancelled out completely, if laboriously, by the low-geared rudder trim-wheel. With maximum continuous power on the live engine, however, and speed reduced to 170 km./hr. (105 m.p.h.) for the optimum asymmetric climb, no further directional trim is available, and a moderate residual foot-load remains uncancelled.

Apart from this deficiency, asymmetric handling is good and from cruising flight at 220 km./hr. (136 m.p.h.), turns were made in each direction with alternate engine feathered without losing height. With the starboard (critical) engine feathered, the single-engine ceiling is some 650 ft. lower than the maximum of 8,852 ft.

I liked the Morava's low-speed performance, and also its absence of marked trim changes except during the asymmetric climb. On closing the throttles to try a clean stall, a fair pull force was needed, while the Morava tended to yaw gently to starboard with reduced speed. Lateral control remained good, with a commendable rate of roll, until a healthy buffet began at about 110 km./hr. (68 m.p.h.) I.A.S. With the wheel not completely back, the L.200A oscillated gently in and out of buffet under full control, a straight breakaway eventually resulting at about 100 km./hr. (62 m.p.h.) I.A.S. Position error is fairly large, the clean stalling speed being 130 km./hr. (80 m.p.h.) E.A.S. at max. gross weight.

For the all-down stall, I lowered the landing gear below 195 km./hr. (121 m.p.h.), trimming out the resultant slight nose-down pitch and feeling a kick through the rudders as the main wheels extended—a useful check for undercarriage operation. Flap limit is 175 km./hr. (198 m.p.h.) and extension to 30° also required a twist of aft trim. With slight power, the Morava began buffeting at about 100 km./hr., I.A.S. and a determined aft pull eventually achieved a stall at 90 km./hr. (56 m.p.h.) I.A.S. accompanied by a mild pitch and starboard wing drop.

Once again, position error necessitates adding some 13 m.p.h. to that indicated airspeed, although the resultant 70 m.p.h., in round figures, is quite representative; and the Morava seemed to have unusually good natural stall warning for a clean, modern airframe. While in the approach configuration, I checked the trim change when opening up to full power to overshoot and found the mild nose-up tendency easy to hold.

The L.200A was also very easy to land, despite its limited visibility coupled with a right-hand circuit on Southend's 24 runway barely visible against a low winter's sun and late afternoon mist. It trimmed well into an approach at 140 km./hr. (87 m.p.h.), which was adequate for a leisurely flare-out with precise attitude control to touchdown from the sensitive elevator. With the mainwheels squeaking on the concrete at 120 km./hr. (74.5 m.p.h.), however, I would have preferred slightly more positive brakes to reduce the landing run.

Better brakes, lighter nosewheel steering, bigger fins and rudders, more cockpit visibility—attention to these points could improve what is already basically a good aeroplane. Such development seems essential if the Morava is to offer serious competition in the international light-twin market, which it could well do on its performance, general flight handling and well-equipped ex-Prague price, with a full panel of British instruments, of £16,072.

MANUFACTURER'S SPECIFICATION

DIMENSIONS.—Span, 39 ft. 4 in.; length, 28 ft. 3 in.; height, 7 ft. 4 in.; wing area, 186 sq. ft.

WEIGHTS.—Empty, equipped, 2,811 lb.; fuel (90 gal.), 663.5 lb.; oil, 48.5 lb.; pilot, 170 lb.; disposable payload, 606.2 lb.; max. payload, 903 lb., permitting 366 lb. (50 gal.) of fuel; max. gross, 4,299 lb.

PERFORMANCE.—Max. level speed, 189.5 m.p.h. at 6,000 ft.; unsupercharged at sea level, 180 m.p.h.; cruising speed, at 8,200 ft., 180 m.p.h.; sea level, unsupercharged, 161 m.p.h.; initial climb, 1,260 ft./min.; single-engined climb, 295 ft./min.; service ceiling, 18,700 ft.; unsupercharged, 16,076 ft.; single-engine ceiling 8,202 ft.; take-off to 50 ft., nil-wind, 1,263 ft.; landing run, from 50 ft., 1,960 ft.; range, at 6,500 ft., 1,025 miles; supercharged, 932 miles; max. endurance, 9 hr. 20 min.

Extended nacelles with relocated exhaust augmentation tubes are a feature of the Morava L.200A, which has a more rounded roof line to the forward cabin.

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Recent MAPAG Lectures . . . .

Manpowered Flight at Southampton

PRESENTING the eighth in the series of Mitchell Memorial Lectures to the Southampton branch of the Royal Aeronautical Society on Nov. 16, Mr. Beverley Shenstone gave a most instructive survey of the background and problems of manpowered flight. It may be difficult to trace any link between this particular form of aeronautical activity and R. J. Mitchell—who was responsible for the Supermarine Schneider Trophy machines and for the Spitfire—but the subject was most appropriate for the Southampton branch as there is an active group in the University engaged in a design for the Kremer competition. And few people are more fitted to talk about such a subject than Mr. Shenstone who—despite his major preoccupation as chief engineer, and now as a director, of B.E.A.—has made a special study of the possibilities of flight by muscle-power alone.

One can compare the present position in manpowered flying, said Mr. Shenstone, with that of the Wright brothers in 1902 when people said that even if they could fly, what would be the use? After all they were trying to glide with very primitive and unstable contraptions which would stand no buffeting of any kind. Now, 58 years later, we were again proposing lightweight and easily breakable contraptions to fly with only ½ h.p. compared with the 15 h.p. that the Wrights needed in 1903. "This can certainly be considered as extremely difficult but it is not quite impossible."

The distinguished lecturer explained that his paper would not discuss whether manpowered flight was possible; this he would accept. He proposed to talk about some of the means of accomplishing it—some of the simplest means rather than the more complex and exotic possibilities.

Here he made the important point that the simplest means that are available are those which have been tried and known. "There may be simpler ways as yet untried," said Mr. Shenstone, "but to find out and prove them is usually far from simple. It is more likely that there are better ways than the simple ways; but they are hard ways and they should be left till later. For example, flapping wings may be better than fixed wings, but you cannot demonstrate it on paper. There is practically no hope for rotating wings."

Mr. Shenstone went on to describe in some detail two early practical manpowered projects of the mid-'thirties—one by Haessler and Villinger in Germany and the other by Bossi and Bonomi in Italy. Both these aircraft flew but neither successfully. The Haessler-Villinger design—with a 44.3-ft. span and a wing-loading of 2.26 lb./sq. ft.—was based on "quite false data on the power a man could produce." The Bossi-Bonomi craft—with a span of 55.7 ft. and a wing-loading of 1.6 lb./sq. ft.—was greatly overweight.

The lessons of these early attempts said Mr. Shenstone were very plain: the basic specification must be right; the designers should get all the data and take advantage of all possible information; and the project needs "just enough" money. He was very concerned about the lack of reliable design data and showed some weight curves he had drawn up based on the little data that existed.

On the subject of control for manpowered aircraft, he said that he had been interested to see efforts being made to design for inherent stability. This he considered a sound trend.

The most arguable item, Mr. Shenstone thought, was the form of drive to be used. Too little was known about drive and bearing losses for the low powers involved, but fortunately experiments on these matters were being done in the Engineering Laboratory at Oxford and the result would be reported to the R.Ae.S. Man Powered Aircraft Group.

Structural materials suitable for manpowered aircraft might, he said, be more akin to those used in model aircraft than in gliders or light aircraft. Wood of one kind or another would be the main material; foam plastics and paper honeycombs were obvious for some purposes; wing coverings might be very light fabric or paper or a plastics film.

Mr. Shenstone concluded his paper by saying that the results of the efforts of MAPAG under H. B. Irving could be seen growing about one. Several sound projects were taking shape. "The main point is," he said, "that serious interest is growing and with any luck some time next year there may be a real, properly designed manpowered aircraft to be seen in flight."

In the lively discussion which followed Mr. Shenstone's much-appreciated paper, a number of interesting points were raised. It was asked, for example, whether the additional weight of an enclosed cabin and its discomfort for the hard-working "pilot" were justified. To this the rep'y came that for manpowered craft one worried less about pilot comfort than about drag.

Another speaker wanted to know about the propeller requirements; these, generally speaking, are as large a diameter as possible coupled with a low r.p.m. Instrumentation requirements were also questioned; an airspeed indicator seems to be all that will be required.

Asked about the possibilities of interconnecting the controls, Mr. Shenstone said that there was no reason why a system such as that so successfully devised for the Ercoupe, with ailerons and elevators only, should not be applied.

On the subject of "powerplant" weight, he said that there was nothing more inefficient than manpower in this sense. He added that one could teach an enthusiastic cyclist to fly so much more easily than teach a pilot to be an enthusiastic cyclist.

Appropriately in winding up the proceedings, the chairman, Prof. E. J. Richards, called upon a member of the Southampton University manpowered aircraft design team to propose a vote of thanks. This was done most charmingly by Miss Anne Marsden.—F.T.M.

Why Birds Differ

IT is wrong to talk of the "comparative efficiency" of different birds, John Barlee told the Man Powered Aircraft Group at the Royal Aeronautical Society on Nov. 30. Aerodynamics is not everything, and the great differences in size, shape, weight and musculature of the wing in different species is in each case Nature's best compromise to suit the way of life of the particular bird.

In the falcon, for instance, the pectoralis major muscle, which pulls the wing down, is 50 times as big as the supracoracoideus, which pulls it up; but in the humming-bird both muscles are of equal size. The guillemot's pectoralis major muscle weighs three or four times as much as its wing, but in the vulture this muscle has only a tenth of the wing weight; this is because the guillemot uses its wings to "fly" under water, whereas the vulture flies almost entirely by soaring. In fact, birds like vultures and buzzards, Mr. Barlee said, can go for two or three weeks without a meal, because they spend so little energy in flying.

Among ducks, the mallard's pectoralis muscle accounts for 25% of its weight, and if alarmed it flies vertically up; but water birds which take off by building up horizontal speed have more muscle concentrated in their legs.

When birds first evolved from reptiles, according to one theory, they developed feathers in order to keep warm, and only later did wings evolve to enable them to escape from their enemies. In parts of the World where birds have no enemies, many of them have lost the power of flight, for the all-round efficiency of birds as animals could be much improved, Mr. Barlee said, if they didn't have to fly.

Mr. Barlee had worked out the power of a bird's muscle as 1 h.p. per 10 lb., assuming a lift/drag ratio of 10 for the herring gull; whereas a man can produce only 1 h.p. per 100 lb. of muscle. This is a surprising difference, even if one reduces it by taking a more likely figure of 1 in 15 for the gull's gliding angle.

One possible cause for the difference is that birds operate at a higher temperature; e.g. divers have a temperature of 105° F., and one German worker gave 113° F. for some birds. Another difference is in the lungs, for the air blows right through a bird's lung, whereas the subdivisions of a mammal's lung end in blind alleys, and the air goes alternatively in and out; thus only 20% of the oxygen breathed in by a man reaches his blood via the lungs, whereas the figure for some birds was given by Mr. Barlee as 40%.

When a bird loses a feather on one wing, a member of the audience asked, does it pull out the corresponding feather on the opposite wing? MR. PETER SCOTT, who was in the chair, replied that when he cut down all a goose's primary feathers on one wing to prevent it flying away, it often took only a month to learn to fly again without them. And Mr. Barlee mentioned that when Mr. W. H. Thorpe clipped a moorhen's wings in a Cambridgeshire fen to prevent its escape, the bird promptly took off at an even steeper angle than before.—A.E.S.

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Observation of after burning in a gas turbine engine at a government research station. This is typical of the many research applications for which television is being used to-day.

C2

Rolls-Royce Plans for Continental Engines

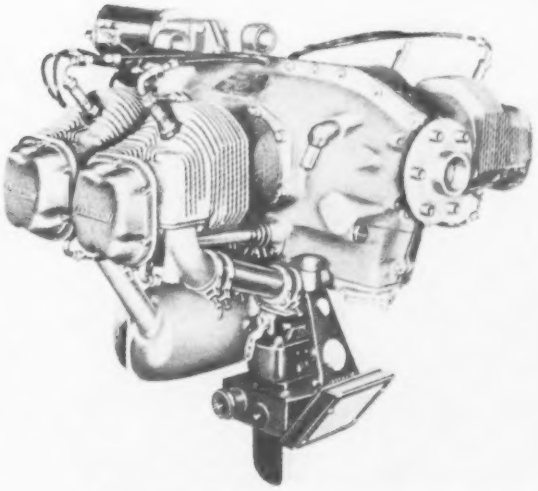
A LARGE proportion of the sales of Continental-designed piston engines built by Rolls-Royce may be made outside Britain, according to Mr. J. P. Herriot, general manager of the company's recently formed light aircraft engine department. This was one of the points Mr. Herriot made in an exclusive interview at Derby, when he discussed the licence agreement between Rolls-Royce and the Continental Motors Corporation, of the U.S.

As described in our issue of Nov. 4, this agreement covers the whole range of Continental piston engines. It gives Rolls-Royce exclusive rights for these engines and spares in Europe, and for Rolls-Royce-built engines in Australia and New Zealand. The company will supply engines, spare parts and full after-sales service. All the parts made by Rolls-Royce will be interchangeable with those from the United States, and the licence agreement covers a 10-year period.

In the two years before the licence was signed, Mr. Herriot made an extensive World-wide market survey. This showed that around early 1959 the total number of active *civil* light aircraft under 10,000 lb. all-up weight, excluding Russia and the Iron Curtain countries, amounted to 82,057. Of this total, 65,312 were on the American Civil Register, and the remaining 16,745 were active in those countries from which it was possible to obtain information; and of those, over 50% were more than 10 years old, indicating a fairly high replacement rate over the next five years.

The fact that foreign light aircraft worth more than £1m. have been imported into Britain alone this year gives an indication of the potential market in the U.K.

An interesting point in Mr. Herriot's survey was the ratio



POPULAR 100-H.P.—A considerable demand for the 100-h.p. Continental O-200 engine is expected in the regions covered by the Rolls-Royce licence. It may be the first of the Continental piston engines to be produced at Crewe.

of light aircraft to scheduled airline aircraft. Excluding Russia and the Iron Curtain countries, but including the United States fleet, there was, at the time of the survey, a total of 4,328 aircraft belonging to the scheduled airlines. These, together with the 82,057 light aircraft, gave a total of 86,385 and showed the percentage of light aircraft to be approximately 95% of the total.

It might be thought that the inclusion of the United States aircraft would tend to weight the results unduly, but this is

Mr. J. P. Herriot, manager of the Rolls-Royce light aircraft engine department, made a two-year market survey of the demand for small aero engines before Rolls-Royce signed its licence agreement with Continental Motors.

not so. Leaving out the United States figures, there was a total of 2,487 scheduled airline aircraft. This figure, together with the 16,745 light aircraft, gives a grand total of 19,232 and shows that light aircraft make up 87% of the total.

The following figures show this tabulated:—

INCLUDING U.S. AIRCRAFT

Total Light Aircraft	Total—Scheduled Airline Aircraft	Total All Aircraft	Percentage of Light Aircraft to Total
82,057	4,328	86,385	95%

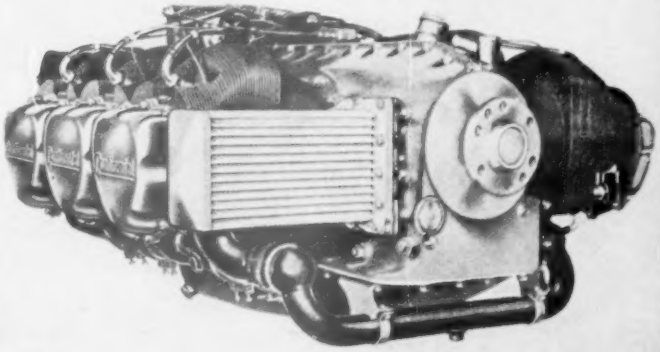
EXCLUDING U.S. AIRCRAFT

Total Light Aircraft	Total—Scheduled Airline Aircraft	Total All Aircraft	Percentage of Light Aircraft to Total
16,745	2,487	19,232	87%

There is a good reason for including reference to the scheduled airlines and the percentage of light aircraft to the total. A recent survey carried out by the management consultants Booz, Allen and Hamilton, of America, for the General Aviation planning group showed that the net value of the two U.S. fleets are both in the neighbourhood of $1,000 million.

In other words, the total value of aircraft and engine business generated by light aircraft operations in the U.S. is very similar to that generated by scheduled airline operation. The significant difference between the two is that the light aircraft market is characterized by low unit cost and high volume, lending itself to mass production and fixed price " off-the-shelf " sales. This, of course, can be equally true for other countries where the percentage of light aircraft to the total closely follows the American pattern.

The Rolls-Royce survey indicated that there was likely to be



260-H.P. FLAT SIX.—The 260-h.p. IO-470 engine will probably be one of the first in the Continental range to be built by Rolls-Royce. It has been specified for the new Beagle Executive.

a considerable demand for both small piston engines and spares. A check on the number of Continental engines currently in use for *civil* light aircraft in Europe alone indicated that there were some 2,500 actively engaged.

Production Plans

The first Continental engines to be produced by Rolls-Royce will probably be of two basic types: 100 b.h.p. (O-200) and the 225-260 b.h.p. (O470/IO-470). The company expects that these will be the powerplants in greatest demand in the regions covered by their licence. Typical aircraft to use the 260-b.h.p. engine will be the Beagle Executive and Cessna 310, built under licence by Max Holste.

Many aircraft in the 100-b.h.p. class could use Rolls-Royce-built engines; a typical example is the Morane-Saulnier Rallye. During market-survey visits to Germany, France and Italy, manufacturers have pointed out how much sales of their aircraft will be helped if they are powered by Rolls-Royce engines.

According to Mr. Herriot, there are at present no duty barriers between Britain and the countries covered by the Rolls-Royce licence. This should help overseas sales of engines and spares; it may also encourage buyers of U.S. light aircraft to import them engineless into Europe, Australia and New Zealand, and then to install engines produced by Rolls-Royce.

Rolls-Royce consider that its small-engine business will be very different in character from its work with large turbojets and turboprops. In selling these, the company is dealing with airlines, ministries and foreign governments, and decisions are often made at high political levels. This will not apply to its work with small engines. These are usually sold direct to manufacturers and individual owners of small aircraft, and the business is more akin to the sale and servicing of motorcars.

For this reason it is interesting that the company will integrate Continental engine production at its Crewe factory, with the work of its motorcar division there. As with motorcars, dealers will be appointed for the Rolls-Royce/Continental engines who will maintain stocks of spares, and offer servicing and overhaul facilities. "We are treating it just like a car job," Mr. Herriot said.

The company may also offer a replacement engine service, in which a replacement engine will be supplied for a fixed fee to replace one needing overhaul. This service will be easier to arrange in Britain than overseas because at present the Customs regulations insist that if an engine is imported for overhaul, the identical engine should be re-exported to its owner.

Rolls-Royce will develop its new piston-engine business in three phases. In the first six months it will import engines direct from the U.S. and tool up for production. After six months it will begin assembling engines from kits of parts supplied from the U.S. In the third phase, starting in 1962, Rolls-Royce will begin assembling engines built by the company. British type-tests must be made with the engine.

Accessories may, in some cases, be British built: they will not necessarily be identical with those on U.S. built Continentals, but will be interchangeable with them. The Air Registration Board is becoming more flexible in its approval of accessories, such as starters which were originally designed for motorcar use. Where possible, accessories of this type will probably be used as they are much cheaper, and, according to manufacturers' records, no less reliable.

Rolls-Royce will not, at this stage, develop Continental engines in any way; its work in this field will be confined to tailoring installations. At present, the overhaul life of the lower power engines is 1,000 hr. and, of the higher power engines, 800 hr.

What of the future? Obviously, the natural follow-on to the piston engine will be the small turboprop, but only, in Mr. Herriot's opinion, when the price and the fuel consumption of the turboprop make it competitive with the piston engine; and, in the light aircraft business, price is an overriding factor.

In America, the general feeling is that the small piston engine has not, by any means, reached the end of its development potential, and is good for another 10-15 years, with turboprops being fed in gradually in about five years' time. The real worry is lack of air space, and the Curtis Report, compiled especially for the President, made great stress of this point.

Light aircraft fly into all the major airports and get the same treatment from the control tower as the scheduled airliners. It is difficult enough to stack small piston engine aircraft, but stacking turboprop aircraft with nearly double the fuel consumption and not much reserve tankage is a major problem, and may well be the main reason for the delay in introducing the alternative type of engine.

This does not mean that Rolls-Royce have dropped their interest in small turboprops. But they will be keeping a close watch on the market.—J.R.C.

More About the Princeton "Gems"

AT Princeton University the James Forrestal Research Center is continuing a research and development programme on its X-3 Flying Saucer and Air Scooter ground-effect vehicles. A 180-b.h.p. Lycoming VO-360-A1A has now been installed in the X-3 to improve performance. With the previously installed 44-b.h.p. Nelson H-63B, the machine was statically stable up to its maximum altitude of 14 in. and its limited manœuvrability clearly defined.

One method of improving performance would have been to improve internal ducting and flow efficiency, but it was decided that a more expedient approach was to install a large amount of power and "blast" off. The X-3 now hovers at 2 ft. and is unstable there, which was exactly as desired in order to study the effectiveness of stabilization modifications. Manœuvrability has also been improved.

Present flight tests are to investigate the effect of stabilizing slots in the base. Next, the engineers intend to improve the feel of the mechanical control system, and then install thrusting ports in the rear for greater forward speed. They hope to be able to increase the speed enough to enter the transition zone of circulation lift.

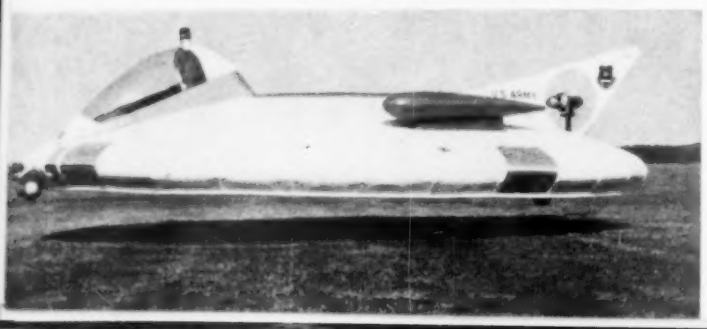
The centre-position propeller is a 4-bladed, 58-in.-diameter wooden unit designed and built by Sensenich. It has metal leading-edges and a special coating to reduce the erosion problem. The tail rotor engine is still the same 5-h.p. Power Products as originally used.

Piper Comanche 15-gal. wing-tip tanks, serving as main fuel tanks, are now installed on each side of the X-3 for balance and easy refuelling. It was also found to be advantageous to keep them out of the internal air flow.

The X-2 Air Scooter was retired to the Army museum at TRECOM, Fort Eustis, but a second generation Air Scooter, the X-4, has since been constructed to examine further the possible performance, stability and control problems inherent in this type of flying machine. Although the X-4 is the same basic machine as the X-2, it has greater power. The 5-h.p. Power Products engine has been replaced by a Yamaha-250 II (YD-II two-stroke engine) motorcycle engine of about 15 h.p.

Again the propeller is a special 4-bladed, metal-edged, wooden fan by Sensenich. The X-4 has an added feature of directional control through the movement of many small vanes in the exit nozzle. These vanes are controlled by the handle-bars, together with the rudder. Rudder and fin are ineffective in hovering, but at speeds above 10 m.p.h. they are necessary to control the destabilizing moment of the inlet duct.

The X-4 has an empty weight of 200 lb. and a gross weight of 380 lb. Construction is steel tubing with aluminium ribs and aluminium skin. It has a 4-sq.-ft. single annular nozzle with a base diameter of 8 ft. and outside diameter of 9 ft. Ground clearance to rigid structure is 6 in. and to the flexible skirt 3 in. Control is kinesthetic (body leaning) and top speed approximately 20 m.p.h.—HOWARD LEVY.



Top left, the latest version of Princeton University's Air Scooter, now powered by a 15-h.p. two-stroke. Left, the modified X-3 with external fuel tanks and a 180-b.h.p. Lycoming.

The Fighting Services

Malayan Awards

THE *London Gazette* for Dec. 7 announced the award of the Air Force Cross to Sqn. Ldr. F. Barnes and Capt. J. Chandler, in recognition of distinguished service in Malaya.

Sqn. Ldr. Barnes was posted to Malaya to take command of No. 194 Squadron, equipped with helicopters, whose number was later changed to No. 110. Until returning to the United Kingdom recently he was on continuous operations in support of the ground security forces. Capt. Chandler commanded No. 7 Reconnaissance Flight of No. 656 Light Aircraft Squadron, Army Air Corps, from July, 1957, to May, 1960, flying as a pilot.

Five other R.A.F. personnel—Flt. Lts. A. J. Archibald, J. D. Bradley, A.F.C., H. H. J. Browning and H. G. Haines, and M. Plt. J. M. M. Walker—have been mentioned in dispatches for service in Malaya.

R.C.A.F. Training Command

WITH the retirement of Air Vice-Marshal J. G. Bryans, C.B.E., from the R.C.A.F. on Dec. 1, the appointment of Air Officer Commanding, R.C.A.F. Training Command, has been taken over by Air Vice-Marshal H. M. Carscellen, D.F.C. Chief Staff Officer with the 4th A.T.A.F. in Germany since 1956, Air Vice-Marshal Carscellen was previously A.O.C., Canadian Air Transport Command.

Bomber Command Inspection

ON Wednesday of last week Air Marshal Sir Kenneth Cross, A.O.C.-in-C., Bomber Command, left the United Kingdom by Transport Command Comet for a 10-day visit to the United States. There he was to visit Strategic Air Command Headquarters at Offutt, Omaha, fly on to the San Bernardino Air Material area, the supply base supporting the Bomber Command Thor force, and inspect Vandenberg A.F.B. where a Thor crew from R.A.F. North Luffenham was scheduled to launch a missile on Dec. 13.

The Thor launching was to be one of the series in the R.A.F. combat training launch programme, in which a total of five completely successful launches have been completed so far. Every three months an operational Thor is withdrawn from a squadron in the United Kingdom for launching from Vandenberg over the U.S.A.F. Pacific missile range, and is replaced by a new missile.

It is only by launching missiles which have been in squadron service that the full aim of the operational training programme can be satisfied. A successful launch then gives the C.-in-C. an assurance of the operational efficiency of the Thor force which would not necessarily follow the launch of a new production missile.

CHANGE OF COMMAND.—On Dec. 2 Gp. Capt. A. V. R. Johnstone, D.F.C. (left), handed over command of R.A.F. Middleton St. George to Gp. Capt. F. Rothwell, D.F.C., who recently returned from a tour of duty as Air Attaché in Bangkok. Gp. Capt. Johnstone has been posted to the Imperial Defence College.

Service Inventions

A TOTAL of £3,500 has been awarded to Service and civilian personnel for their ideas for improving the function of R.A.F. equipment.

Two civilian employees have received an Air Council award of £3,000 for their work on a device connected with cipher equipment. M.Tech. T. W. Thomas, of R.A.F. Henlow, has been awarded £25 by the A.O.C.-in-C., Flying Training Command, and a further £25 by the Air Council, for designing a modification to Alvis Leonides engines which prevents oil from entering the valves controlling the pneumatic pump system.

Cpl. R. J. Rickards has received a total of £30 for his design of a test rig for starter circuits of turbine engines. S.A.C. D. Templeman has been awarded £35 for the invention of a nozzle which, when connected to a compressed air line, facilitates the threading of wire into plastic insulating tubing. Two chief technicians each receive a total of £100 for the development of equipment used for checking the accuracy of an aircraft test set.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. K. W. J. Tarrant, D.F.C., and Wg. Cdr. P. D. Thompson, D.F.C., to the Department of the Chief of the Air Staff; Sqn. Ldr. B. de Burton, M.B.E., to the Department of the Air Member for Supply and Organization, with acting rank of Wg. Cdr.

Bomber Command: Wg. Cdr. J. C. Hunter, O.B.E., to R.A.F. Upwood to command the Administrative Wing.

Fighter Command: Gp. Capt. J. H. D. Chapple to Headquarters

SERVICE FAMILIARIZATION.—The Secretary of State for Air, Mr. Julian Amery, went to R.A.F. Waddinton recently as the first of a series of visits to various Commands. Accompanied by Air Vice-Marshal J. G. Davis, A.O.C., No. 1 Group, and the station commander, Gp. Capt. D. Iveson, he met aircrew and watched a 1-min.17-sec. scramble by four Vulcan B.1s of No. 44 Squadron.

as Command Work Study Officer; Gp. Capt. E. W. Wright, D.F.C., D.F.M., to Headquarters as Group Captain, Operations I.

Maintenance Command: Wg. Cdr. G. R. Cook to Headquarters as Wing Commander, Plans.

Signals Command: Wg. Cdr. E. R. H. Caven to Headquarters as Command Accountant.

Middle East Air Force: Gp. Capt. R. E. Beeny, O.B.E., to Headquarters as Command Signals Officer; Wg. Cdr. P. E. H. Thomas, A.F.C., to R.A.F. Nicosia to command the Flying Wing.

Other Appointments: Wg. Cdr. R. S. Harries, M.B.E., to the British Defence Services, Washington; Sqn. Ldr. J. L. W. Towler to the United Kingdom Services Liaison Staff Australia for joint planning liaison duties, with acting rank of Wg. Cdr.

More Service News

Royal Visitor.—H.R.H. the Duchess of Gloucester, Air Chief Commandant of the W.R.A.F., visited Adastral House last week to meet the Director, Air Cdt. A. Stephens and her staff. On arrival, the Duchess was greeted by the Air Member for Personnel, Air Marshal Sir Arthur W. B. McDonald.

No. 87 Squadron Disbandment.—No. 87 Squadron at R.A.F. Bruggen (B.F.P.O. 40) is disbanding early in the New Year and the C.O., Wg. Cdr. G. C. Lamb, A.F.C., extends a welcome to former members to attend a farewell parade to be held at 11.30 hrs. on Jan. 3, 1961. The salute will be taken by the A.O.C., R.A.F. Germany, and the Squadron will be hosts to visitors at a party the same evening. Those planning to attend should inform the C.O. so that the accommodation and transport can be provided.

W.R.A.F. Officer Recruiting.—The age at which candidates may be selected for training as W.R.A.F. officers has been reduced from 18½ to 17½ years. Although they will not be eligible to start training until they are 18, the new scheme is intended to help to overcome the problem of stop-gap employment for school-leavers. Another new step to encourage recruitment of W.R.A.F. officers is that women with university degrees and certain professional qualifications may in future be selected for direct appointment to General List permanent commissions in a number of branches.

R.A.F. Recruits.—Of all entries into the R.A.F. during the three months ended Sept. 30, 20% were former members of the A.T.C. or of R.A.F. Sections of the Combined Cadet Force. Recruits from all sources during this period totalled 6,286—of whom 1,246 were former air cadets. This shows a 5% improvement over the same period in 1959.

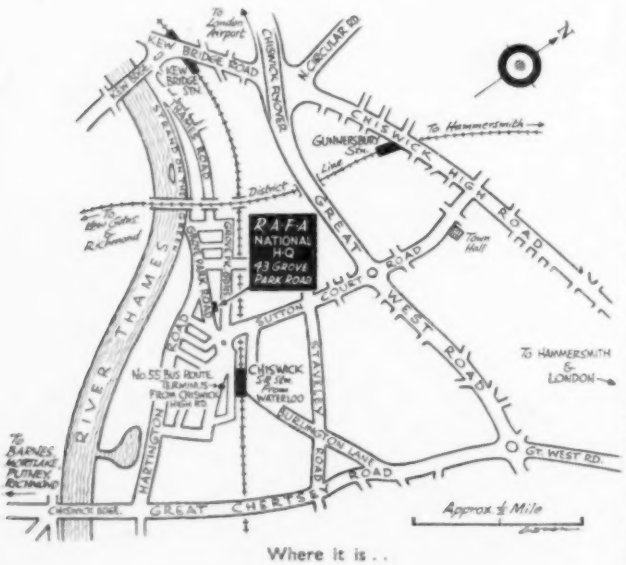
R.O.C. Headquarters.—The fifth underground headquarters for the Royal Observer Corps was opened by the Lord Lieutenant of Lincolnshire on Dec. 10. Situated at Fiskerton, near Lincoln, it is for No. 15 Group. In addition to these headquarters, 800 out of an eventual 1,500 heavily protected R.O.C. posts have been completed.

New Home— Old Tradition

BECAUSE its old National H.Q. building in London's Portland Place is being pulled down the Royal Air Forces Association has had to move. They have followed the trend and left crowded, expensive, Central London to settle at 43 Grove Park Road, Chiswick, W.4.

When I called on Gerry Boak, the Association's genial and capable general secretary, I was actually able to park my car right outside the front door. More important advantages are easier staff recruiting from local people, facilitation of mail-handling and having, for the first time, all N.H.Q. staff under one roof. Committee meetings are held there but National Council meetings assemble in one of the Air Ministry's Historic Rooms.

The Association has some 90,000 members in 754 branches, including 69 branches in the Commonwealth and such unlikely places as Swaziland, Missouri, the French Riviera, five of the South American countries, Israel and the recently formed all-French *Sud-Ouest* branch at Merignac. There are also branches on Christmas Island, in the Stock Exchange, the House of Commons (with 60 members) and a House of Lords branch is being formed. Mr. Julian Amery, Secretary of State for Air, is joint president, with Lord Shackleton, of the Preston branch.



Where it is . .

What it looks like.

Broadly, the R.A.F.A. has two separate aspects—welfare and social. The organization helps *all* who are serving or who have served in the Forces from which it draws its membership, whether or not they are R.A.F.A. members. In fact, 83% of the people helped this year were not members, although some joined subsequently. Its services complement, without overlapping, those of the R.A.F. Benevolent Fund.

Gerry Boak put it this way: The R.A.F.A. provides the lighthouse and navigation aids for all, including the National Servicemen, to keep them and their dependants on course; the Benevolent Fund, whose help is limited by Charter to the Regular and his dependants, supplies the salvage service in the event of disaster. Since 1948 the Association's Battle of Britain Day's collections have contributed over £220,000 to the Fund.

Next year's Annual Conference will be held during Jne. 2-4 at Douglas, I.o.M., where the serious and social sides will be seen at their best. Decisions taken there may have a bearing on a national need. If so, the R.A.F.A. can put it to the Co-ordinating Committee of the British Services and Ex-Services Association on which it is represented along with virtually every similar association of all the Services—Navy, Army, R.A.F., British Legion, St. Dunstan's, women's as well as men's organizations. They can thus speak with one loud voice in Parliament and elsewhere.

The "pull-together" spirit of the War is perpetuated in the Association. Since it started in 1930 as the Comrades of the R.A.F. the bonds of service and mutual help have drawn to it men and women of all ranks. The Queen is Patron, the Duchess of Gloucester is Vice-Patron. Lord Tedder follows Lord Trenchard, Lord Newall, Sir Richard Peck and Prince Philip as President. Air Marshal Sir Robert Saundby, well known to readers of THE AEROPLANE, was chairman of the National Council during the Association's momentous years 1945-58 and has been succeeded by Sir Harold Lydford.

Led by such men and supported enthusiastically by its members, the R.A.F.A. offers a great deal to all men and women in and out of our Air Forces. With an annual subscription of 7s. 6d. it can be said that rarely in the field of comradeship was so much offered to so many for so little.—WREN.

British Views on Supersonic Airliners

SONIC bangs and operating costs are two of the greatest current problems of supersonic airliners—and the bangs may add greatly to the operating costs if they prevent the aircraft from cruising at their design speed over populated regions. This was the dominant point made at the all-day symposium on supersonic transport aircraft held at the Royal Aeronautical Society on Dec. 8. A thorough survey of the current "state of the art" and British thinking in this field were given by 10 lecturers from the aircraft and aero-engine industries, the Ministry of Aviation, B.E.A. and B.O.A.C.; they are listed on p. 809.

Noise problems are clearly exerting a tremendous influence on the design of the supersonic airliner. Noise produced during ground running and the take-off and climb affects the choice of powerplant, but nowadays this is not expected to be as much of a problem as the supersonic boom during the cruise. In the extreme this may compel countries to ban supersonic flying over land.

If this happened, aircraft would probably need to be designed differently to cope with flying long distances subsonically. Certainly it would have a very bad effect on operating costs which, even without this drawback, are unlikely to be competitive with operating costs of subsonic transports in 1970 when supersonic airliners are expected to enter service.

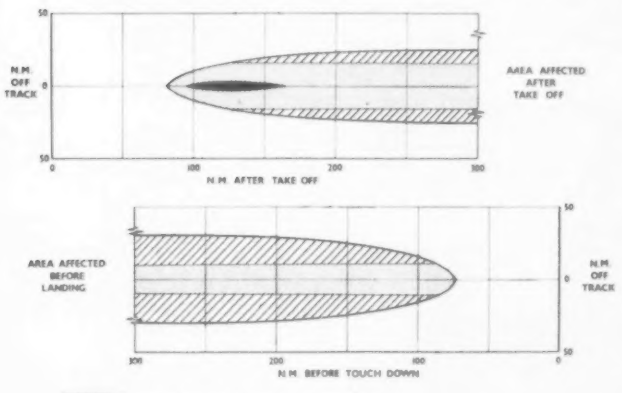
Members of Hawker Siddeley, the company which has not received a follow-on design study, made a particular point of this problem. It was introduced by Mr. Sutcliffe in his talk.

In the diagram shown on this page he indicated that, even when cruising at 80,000 ft., a supersonic airliner would produce a boom intensity pressure at ground level of between 1 and 2 lb./sq. ft. This is considered an objectionable noise, equivalent to close-range thunder and likely to cause some window damage. It would probably be unacceptable.

Messrs. Morris and Stratford, also of Hawker Siddeley, took this point further by showing the effect on operating costs if supersonic flight over land were not permissible—for example, direct operating costs between London and Johannesburg would go up by about 50%. It was also shown how many airline routes, potentially suitable for supersonic operation, would be excluded, with consequent reduction in prospective sales for supersonic transports.

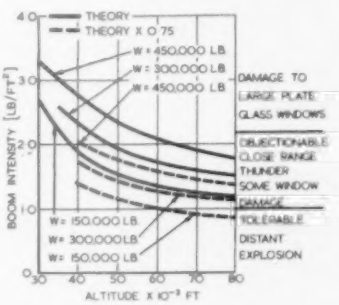
This problem is taken seriously by the airlines, as Mr. C. H. Jackson of B.O.A.C. indicated. He showed a map of B.O.A.C. routes with operation limited to subsonic speed over all land which had a population density greater than 50 persons per sq. mile. This greatly curtailed supersonic operation and he felt that a decision on boom effect was vital, as it might decide which type of aircraft should be produced. The implications of this problem should, he thought, be decided before starting design work.

The suggested drastic influence of supersonic boom did not go unchallenged; both its magnitude and effect on people were questioned. Interestingly, as mentioned on p. 705 of our Nov. 25 issue, Boeings have been very worried by this problem.



BANG AREA.—This diagram by Sutcliffe shows the areas affected by sonic boom from a Mach 2.2 transport. It assumes the full theoretical pressure rise and a reflectivity factor of 2 (giving the pressure rise as experienced by a person on level ground).

Their calculations of pressure rise and its effect tally with those of Mr. Sutcliffe. But their studies show that 75% of air traffic for ranges above 2,000 n.m. is over ocean routes or land areas with low populations, and they expect a demand for 50 supersonic airliners a year from 1968-70 onwards may be possible.



Even when cruising at 80,000 ft. a Mach 2 transport would produce an objectionable sonic-boom pressure rise, according to Sutcliffe. The 0.75 factor is based on recent U.S. flight and wind-tunnel work, but does not bring the intensity down to an acceptable level.

Problems of direct operating costs were highlighted by Mr. Jackson. He felt that designers' figures, particularly U.S. ones, were suspect. Not enough information was yet available to judge the prospects correctly. Cynical operators might even assume that costs would be as much as twice those of subsonic airliners.

Subsonic costs were tending to be reduced; by 1970 90% of passengers were expected to travel economy class. In the past passengers had paid less for a better service year by year; could they be expected to pay more in 1970? The supersonic airliner must enter service with operating costs which were at least as low as those current today.

The possibility of bringing costs down by the use of laminar-flow techniques was mentioned in the discussion by Mr. G. H. Lee (deputy chief designer, Handley Page). He said that direct costs of about 12d./ton-mile for subsonic transports might be reduced to 9d. or 10d.—or to 6d. with laminar flow—and this was the level of cost with which the supersonic transport might need to compete. He considered that the M=2.2 transport would cost about 15d./ton-mile; we would need to do much better than that and he suggested that we should use simple variable geometry techniques (as, for instance, the yawed wing) for improving this figure to 10d. or lower.

Several questioners pointed out that costs should be studied as a whole, and that indirect costs should be thoroughly investigated. Was it logical to expect that they would be equal to direct operating costs, as was traditionally asserted?

Although some aspects were hotly debated, it was very interesting to find that other characteristics of the British supersonic airliner were taken as decided. There was no debate on the merits of Mach 2.2 and Mach 3 as cruising speeds; as the joint chairman, Mr. M. B. Morgan, said, it was a "Mach 2.2 transport symposium."

Equally the configuration was not disputed. All the lecturers assumed that the only aircraft being considered was a narrow delta, although Mr. Wilde showed how the ideal shape for high L/D must perforce be modified to meet off-design needs. And Mr. Sutcliffe advanced some convincing reasons for using podded powerplants instead of semi-buried installations. On the testing side this approach was preferred by a representative of the N.G.T.E.

Propulsion did not seem to be considered as a major problem; most effort was needed on intakes and exhaust nozzles. For the engine itself high-temperature operation is needed to give high thrust per unit of powerplant area and weight. According to Mr. Pearson, of Rolls-Royce, current thinking assumes a cruising temperature of around 1,350° K., equal to the highest temperature used today for take-off. The main need was a turbine-blade alloy some 100° C. better than current materials.

The onus of this lies on the metallurgist; this and other material needs are likely to be, in U.S. jargon, "problem areas." According to Dr. Megson, radome materials, elastomers and adhesives are likely to be satisfactory up to Mach 2.2 but transparencies may cause difficulties.

Any increase in operating temperature will greatly add to the problems; most of the new non-metallic materials he mentioned for higher temperatures come from the U.S. On structures, Mr. James of Vickers-Armstrongs, felt it was very important that the significance of kinetic heating should not be exaggerated.

One encouraging feature of development was mentioned by

Mr. Jameson of the A.R.B. Flight proving time has always been a problem and astronomic totals of hours needed have been mentioned in the past. Proving time will be affected by how well the aircraft behaves relative to its design targets. In his view, unless full advantage is taken of all possible methods of alleviation, about 15,000 hr. of flying between first flight and passenger service may be needed to establish confidence that the normal safety level will be reached.

For route proving it would be well to allow for at least one year of operation, according to Mr. Jameson. This would include exposure to a fair sample of operators' personnel, facilities and procedures: experience of a wide range of climatic conditions during flying and maintenance; maintenance of several individual aircraft over a full cycle and one or two aircraft over two or more full maintenance cycles; and the collection of statistical records sufficient to support initial introduction into service.

Aerodynamics

Mr. M. G. Wilde, a leading member of the B.A.C. design team which has the main contract for supersonic studies, provided a paper that was very interesting in the clues it gave to B.A.C. thinking. He took as his starting point a Küchemann analysis of a Mach-2 slim-delta aircraft with a wing area of over 6,000 sq. ft. and volume 18,600 cu. ft. For this the semi-span to length ratio would be 0.202 to give the maximum lift-drag ratio of 8.9 during cruise.

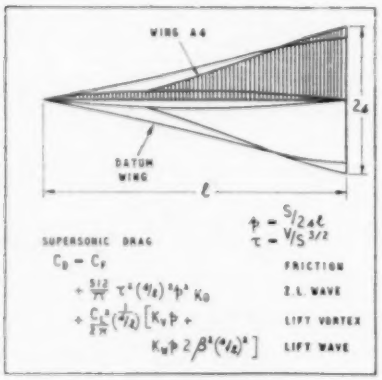
This aircraft would seat about 100 tourist-class passengers in a fuselage 165 ft. long. The fuselage would occupy 8,600 cu. ft. and the 10,000-cu.-ft. wing volume would hold the 158,000 lb. of fuel needed for North Atlantic operation. The take-off weight would be 300,000 lb., and the payload 24,000 lb.

Only 51% of the fuel carried is burnt in the cruise. The rest is used for the take-off, climb, descent and landing and a further amount carried as a reserve. This reserve allows 1 hr. 40 min. subsonic holding at altitude; it is about the amount operators expect will be needed.

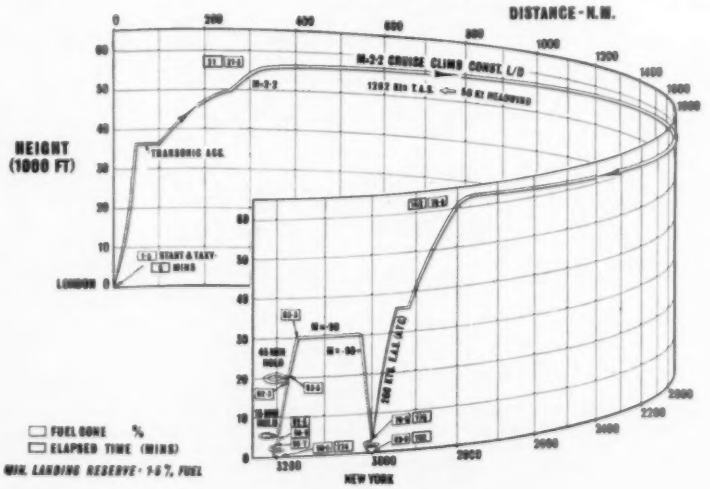
With a relatively small part of the fuel burnt in cruise, it is unlikely that this datum aircraft will be the correct choice. Improvements may be found in several areas—speed and controllability on the approach, airfield performance and fly-over noise for example—and, provided such improvements are achieved at no significant economic penalty, the compromise aircraft is more attractive.

In studying variations, the fuselage geometry, overall volume and take-off weight were maintained constant. The first condition fixes the payload. If the fuel calculated for the stages does not vary greatly, then constant volume ensures adequate stowage space for fuel in the wing. Finally, the direct operating costs at fixed payload vary directly with take-off weight to a first approximation so that holding this constant ensures similar costs for each variant.

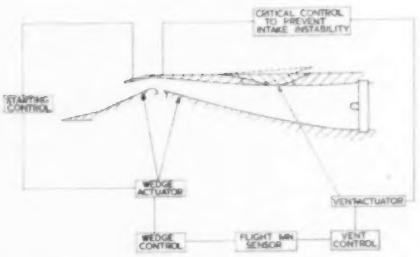
By reducing wing area to 4,900 sq. ft. and increasing the aspect ratio, the approach speed can be reduced from 156 to 140 kt., the take-off distance reduced from 11,000 to 6,800 ft.



COMPROMISE LAYOUT.—The datum wing, based on Küchemann theory, has the optimum cruise L/D ratio of 8.9. The shaded wing A4 with a separate fuselage is a compromise configuration with better low-speed performance (Wilde). It is described above.



FLIGHT PLAN.—Fuel consumption and time gone are shown for a non-stop transatlantic operation by a Mach 2.2 airliner. Only 54.2% of the fuel is used during the cruise (Sutcliffe).



Features of the intake control system for a supersonic transport are shown here (Pearson).

and the fly-over noise cut from 132½ to 111½ PNdb. There is a negligible difference in operating cost. With the compromise aircraft the wing and fuselage become distinguishable, rather than integrated, and they must be designed as far as possible to give favourable interference effects during the cruise.

Propulsion

Both Mr. Pearson of Rolls-Royce and Mr. Reed of Bristol Siddeley, in their papers, came out in favour of pure turbojet engines rather than turbofans, but the aircraft designers were not fully convinced on this; they felt that the choice depended on noise requirements. Mr. Reed indicated that a turbofan transport would weigh 4.2% more than a pure-jet one and have operating costs 5% greater. This conclusion is interesting, because Bristol Siddeley are already developing a Mach-2 Olympus for the TSR-2.

Mr. Pearson said that the air intake was one of the most critical powerplant components because the pressure ratio obtained from it is rather greater than that given by the main engine compressor. The problem is largely one of matching.

If a fixed intake is used, there is high spillage drag at the design speed. With a variable-wedge intake, whose angle can be varied to give good intake pressure recovery over a wide range of speed, there will be an excess of air at lower flight Mach numbers which will involve spillage if the intake critical flow is matched to the cruise condition.

The sort of intakes envisaged for a transport aircraft, therefore, consist of a centrebody intake, preferably two-dimensional, whose wedge angle can be altered to suit flight conditions. Spill valves duct air overboard and past the engines for low flight Mach numbers, and to ensure that the intake starts satisfactorily. A variable intake, which automatically matches these requirements and also re-adjusts itself to prevent intake buzz or instability, is a major development and the control system of the powerplant is a major part of the design.

The expansion ratio across the engine final nozzle is around 12 : 1 at a flight Mach number of 2 and substantial performance gains are obtained by efficient supersonic expansion. In principle, therefore, a convergent-divergent nozzle is required for the cruise condition.

However, at lower aircraft speeds, and in particular for take-off, a pressure ratio of about 2½ is all that is available, and for this pressure ratio such a convergent-divergent nozzle would give large losses and in any case would probably become unstable and exert large fluctuating side-loads on the engine. Some form of variable nozzle, therefore, is required. The rear end of the powerplant represents a critical design problem in

(*Continued on page 809*)

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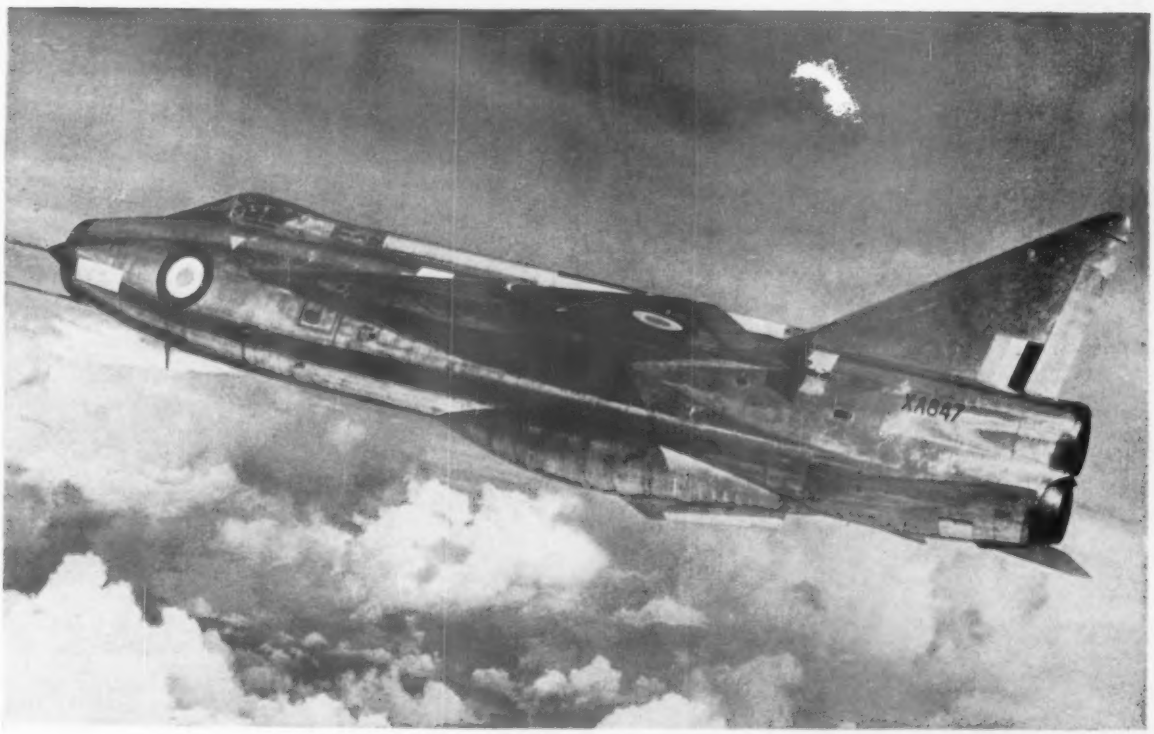

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(*Continued from page 808*)

the transonic flight phase and Mr. Pearson considers that a satisfactory solution has not yet been reached.

Mr. Sutcliffe said it was hoped that pressure recoveries as high as 92% at M=2.2 would be achieved within the next decade, with throat bleed penalties below 5% of entry mass flow. He went on to argue in favour of podded installations. He said that the original ideas on engine installation were based largely on the "buried" or "semi-buried" arrangements where the excess area of the engine plus surrounding structure over the intake area was buried within the aircraft to minimize the external wave drag. Blocks of two or three engines, lying side by side behind "two-dimensional" intakes, were proposed.

Podded engines were not favoured because of the large ratio of engine plus structure area to intake capture area, and consequent high wave drags. Recent work, however, has shown that the increased capture area, due to higher intake efficiencies now thought possible, plus refined cowling techniques which reduce the engine's carcase area, makes the ratio of these two areas very nearly unity.

A podded installation now seems possible without large drag penalties. Hawker Siddeley estimates for the total drag of the podded installation are almost identical with those for the semi-buried installation. The weight of the two systems is also very similar, the increase in weight due to the pylon being offset by the much reduced weight of the circular intake and exit compared with the large flat moving surfaces of the semi-buried arrangement.

Two final considerations appear to weigh very heavily in favour of the podded arrangement. The biggest single problem of the semi-buried arrangement is the treatment of the aircraft boundary layer, which can be as deep as 8-10 inches at the intake ramp.

Some means of removing or deflecting this boundary layer must be found and this can cause considerable weight and drag penalties. But with the podded installation the only boundary layer is that on the centrebody itself and relatively simple and well-tried suction methods can be used for its removal.

There is little doubt that the accessibility of the podded installation is much superior to that of the buried arrangement and furthermore a change of engine type or size can be accommodated much easier. For these reasons Mr. Sutcliffe concluded that the podded arrangement offers a less complicated and more flexible engine installation than the semi-buried one for little or no penalty drag and weight.

Control-cabin Design

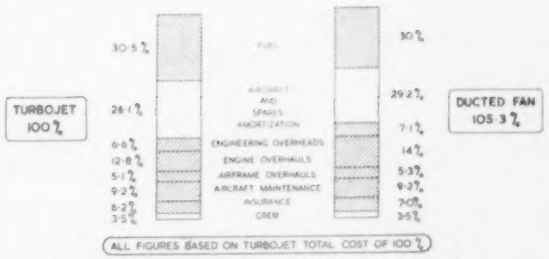
Using the flight-deck proposals for the D.H.121 as a guide towards further improvements, Capt. F. Ormonroyd (B.E.A.) summarized a few of the "musts" for the pilot of the supersonic transport. Rate of error increased with complication and personal disturbance—so the objectives must be simplification and a comfortable working environment. The pilot must become a manager rather than simply a servo mechanism.

One of the most important aids required—particularly in a slim delta with high angles of attack at low speeds—was a head-up take-off director display; the Smiths P.V.D., planned for the 121, could be developed for use in this régime and to control the roll-out after landing, as well as during other phases of flight. The auto-pilot of the future would need to have much more authority and more and better auto-coupling and lock facilities.

There had, Capt. Ormonroyd thought, been bad thinking on instrumentation problems. There was no practical difference in readability between the 2-in. and 3½-in. instruments and the smaller dial permitted closer grouping, with easier and more effective scanning. Simplification of instrumentation would permit the coaming to be lower and provide the necessary better range of view in the vertical plane. Modern systems would allow the present massive type of control column to be dispensed with in favour of a small, tiller-like control, and this would also help to clear the decks and lead to a better range of view.

The reproduction on the lecture-hall screen of a B.E.A. flight-chart for the Moscow run showed not only how the pilot's job can be simplified, but also the present complications, in terms of reporting points and frequency changes, of an A.T.C. system which has not kept up with the increasing speed of aircraft.

This point was stressed in the discussion by Capt. A. P. W. Cane (B.O.A.C.), who pointed out that changes had been recommended 10 years ago (prior to the introduction of the Comet 1) and had still not been made. What hope was there of a suitable environment for the supersonic transport 10 years from now? His comments were equally vigorous when, referring to the need to have turbulence-free air for the transition from subsonic to supersonic flight, he said that smooth, above-the-weather, conditions had for 30 years always been just a little way farther up.



COST COMPARISON.—A ducted-fan transport would have an operating cost 5.3% higher than that of a pure-jet airliner, according to Reed.

Systems Problems

The basic points made by Mr. R. C. Morgan in a paper read in his absence by Mr. W. B. Shaw (Aircraft Development Manager, B.E.A.), were that the requirements in vital systems for the supersonic aircraft were similar to those for advanced subsonic aircraft, and that multiplication will continue to be necessary for reliability. Components could never be so reliable that such multiplication would be unnecessary. The systems would be operating in a much more difficult environment, and temperature conditioning would be needed for systems as well as for passengers.

In the paper and the discussion which followed the important point was made that fault-diagnosing methods—which would become increasingly important—must not be so rigid that total divergences in performance (caused by a combination of exceeded tolerances) would cause the aircraft to be grounded. The equipment must be such as to point to the faulty component. Although the achievement of a higher component reliability might, theoretically, be better in the long term, the fact remained that failures would occur and that multiplex systems were the only means of protection against the results of these failures.

The Primary Challenge

The solution of the technical and operational problems posed by the supersonic aircraft will be pointless if the costs are too high for the airlines. Mr. C. H. Jackson put the matter clearly when he said that every transport aircraft introduced by the airlines had so far shown at least the potentiality of lower ton-mile costs and that no carrier was likely to accept an aircraft which reversed the trend. Cost, therefore, was the primary challenge.

The supersonic aircraft would be more difficult to schedule for high utilizations and there would be objections to any airline fleet-pooling arrangements which might be made in order to obtain higher utilizations.

In the discussion the point was also made that the introduction of supersonic aircraft would produce an unbalanced transport system in which New York might be nearer to London than, say, Rome. The importance in overall speed of city-centre to airport times was stressed by another speaker and it was suggested that any useful reduction in these times might cost more than the supersonic transport. To the proposition that passengers would be prepared to pay a premium for speed, the answer was that nobody knew how many passengers would be prepared to pay this extra fare in 1970. As it was put in one of the concluding addresses—the price of the ticket is the thing that finally counts.

SYMPOSIUM LECTURERS

Aerodynamics	M. G. Wilde, assistant chief engineer, Bristol Aircraft, Ltd.
Kinetic heating related to structural integrity	D. James, chief structural engineer, Vickers-Armstrongs (Aircraft), Ltd.
Materials	Dr. N. J. L. Megson, director of materials research and development, Ministry of Aviation.
Propulsion problems	H. Pearson, chief engineer (performance and research), Rolls-Royce, Ltd.
Engines for the supersonic transport	A. V. N. Reed, deputy chief project engineer, Bristol Sidde'ey Engines, Ltd.
Aerodynamics related to propulsion and noise	P. L. Sutcliffe, chief technician advanced projects group, Hawker Siddeley Aviation, Ltd.
Airworthiness	D. M. Jameson, in charge of Air Registration Board advanced projects group.
Cockpit design and management	Capt. F. Ormonroyd, flight technical superintendent, British European Airways.
Systems engineering	R. C. Morgan, chief project and development engineer, British European Airways. (Lecture read by W. B. Shaw, B.E.A. aircraft development manager.)
Operation and economics	C. H. Jackson, assistant chief engineer, British Overseas Airways Corporation.

Solid Rocket Boosters

Points from a recent lecture given before a meeting of the R.Ae.S. Astronautics and Guided Flight Section outlining the evolution and development of modern solid propellents.

ALTHOUGH liquid propellent rockets have dominated the development of large ballistic weapons and space-boosters since the advent of the German V-2, recent advances in solid propellent engineering show promise of changing this situation radically in the years to come. The trend began some time ago in the United States with the development of the fleet ballistic missile, Polaris, already at sea with the nuclear submarine "George Washington," and with the second-generation ICBM, Minuteman; the latter is shortly to be test-fired for the first time from Cape Canaveral.

On the score of space-boosters, the NASA all-solid, four-stage, Scout has entered its test-phase at Wallops Island, Virginia. First stage of this rocket produces about 115,000 lb. of thrust and weighs more than 22,000 lb. It is the largest of its kind to be successfully fired in the United States.

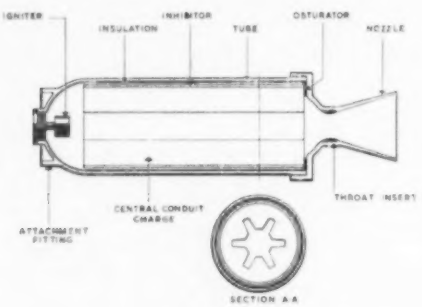


Fig. 1. Solid propellent motor (loose charge).

Scout is, of course, the economical booster designed to orbit a payload of 150 lb. at an altitude of 300 n. miles. It is scheduled to launch the first U.K./U.S. satellite towards the end of next year. There is a U.S.A.F. variant—Blue Scout—to be used as a high-velocity research probe.

Interesting things are also happening with solid rockets within the research departments of the U.S. Navy. There are reports of a multi-stage development of Polaris to act as a space-booster using for its upper stages components obtained from the Scout programme. Launchings of this combination could be made from conventional land sites or—according to one Naval spokesman—from a floating launching platform, possibly a converted dry-dock.

Air-launching of small satellite rockets has also been under active development by the U.S. Navy since 1958. Staged solid rockets have been fired from the Douglas F-4D Skyray (Mach 1.05 at 36,000 ft.) in preliminary experiments. Latest studies under the Pilot programme are centred upon the McDonnel F4H Phantom which is capable of Mach 2 at 36,000 ft.

A four-stage, all-solid, rocket weighing 3,000 lb. with an initial thrust of 12,000 lb. is being developed for supersonic launching by F4D and F4H aircraft. The combination should be capable of orbiting payloads of 15 to 25 lb. at 300 n. miles.

At the other end of the scale, NASA has initiated design studies for "super-size" solid-propellent engines for use in space-boosters weighing one to seven million lb.; these would have thrust levels two to three times the vehicle weight.

In view of these varied developments in the United States, the recent lecture by Dr. W. R. Maxwell and Dr. G. H. S. Young of R.P.E., Westcott, on the subject of "Solid Propellent Rocket Motors," is of particular interest; they were speaking before a meeting of the Astronautics and Guided Flight Section of the Royal Aeronautical Society on Dec. 6. What follows is a condensed reading of their comprehensive paper.

Propellent Types

The two main classes of solid propellent used today are usually termed double-base and composite. The distinction, which is largely historical, is made according to the nature of the chemical system used. If the oxidizer is a solid crystalline material, such as ammonium nitrate or ammonium perchlorate, the propellent is "composite"; if the system is mainly nitroglycerine and nitrocellulose, essentially in a gelatinized form, then the propellent is usually termed "double-base."

However, these distinctions are now largely for convenience, since double-base propellents may contain solid oxidizing salts and composite propellents may contain nitroglycerine or similar esters as plasticizers. The principal solid propellents under current investigation in the United Kingdom are: double-base propellent, either in an extruded or cast form; plastic propellent, which is a putty-like composite propellent; and, more recently, polyurethane propellent which is an elastomeric or rubbery composite.

Essentially, in the manufacture of all these propellents, the various ingredients are mixed either as a slurry or as a type of dough. The machines used are conventional, and similar to those employed in the bakery and confectionery trades. However, special precautions have to be taken to prevent violent impacts and it is usual to conduct the mixing in relatively small batches of not more than a few hundred pounds.

After mixing, the processes become dissimilar. Double-base propellent of the cordite type is extruded, by large presses, into the required shape. It is then inhibited on the outer surface by some suitable non-inflammable material. The charge is loaded loosely in the rocket motor.

Double-base propellent of the cast type is first extruded into small grains, or cylinders, which are poured into a special mould. Casting liquid, a desensitized nitroglycerine mixture, is then introduced, and the whole charge "gelled" by keeping at an elevated temperature for a few days. These charges are also inhibited, like extruded cordite, and are loaded loosely into the rockets.

Plastic propellent, which, after mixing, has the consistency of a stiff putty, is first de-aerated and then formed into shape in the actual rocket motor tube by extrusion or compression moulding. This propellent is bonded directly to the tube and hence requires no inhibition on the outer surface.

Polyurethane propellent, after mixing, has the consistency of a cream and is poured directly into the motor tube. It is then cured by holding at a slightly elevated temperature for a few days. This propellent is also bonded directly to the motor case, and after curing has the appearance of a stiff rubber.

In the plastic and castable composite propellents the fuel-binder must have special properties. In the case of plastic propellent it must be a highly viscous liquid, with a low freezing point, of which the viscosity does not change much with temperature. This ensures that the propellent does not become brittle at the lowest operating temperature and does not flow out of the rocket at the highest operating temperature. Polyisobutene, of medium molecular weight of about 10,000-15,000, satisfies these requirements and has the advantage of chemical inertness.

For polyurethane propellents the binder must be sufficiently fluid to remain pourable even when loaded with 75-85% of solids. However, if it is of very low viscosity, sedimentation will occur, since ammonium perchlorate is appreciably more dense than most organic binders. The oxidizer is frequently added in two or more size distributions to assist mix fluidity and sometimes surface active agents are added as well.

After casting, the charge is formed by polymerization or

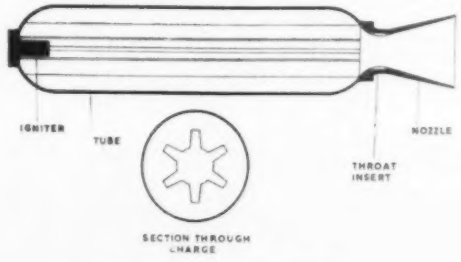


Fig. 2. Motor with case-bonded charge.

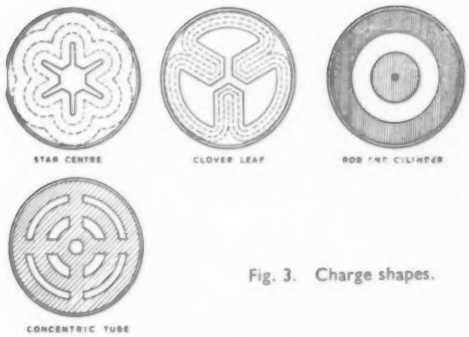


Fig. 3. Charge shapes.

curing. This process must take place at a relatively low temperature, and must evolve little heat. In addition, for large rockets, any appreciable expansion, or shrinkage, on cure is undesirable. Obviously also, for economic reasons, the curing time should not be more than three or four days, and the curing agents should be non-reactive with the oxidizer and other propellent ingredients.

The greatest interest at the present time is the increasing size of solid propellent rockets. Polaris and Minuteman, for example, are powered by solid propellents, and are in the size range formerly thought of as the sole province of liquid propellents.

Obviously for such large rockets, extrusion processes would be uneconomical, and a plastic material might be unsuitable. Hence attention is being given to propellents which can be slurry cast, and which are case-bondable. The two most favoured systems are those based on the Thiokol polysulphide synthetic rubber and on the polyurethane rubber.

The latter type has special interest in this country since the basic ingredients are more readily available, and are capable of covering a wider range of physical properties. The curing reactions take place at comparatively low temperature and with little heat evolution. Consequently the manufacture of large rockets is much simplified.

Propellent Shapes

Most rockets are required to operate at constant pressure and this means that the area of the burning surface must be kept constant. Examples of how this can be done are given in Fig. 3.

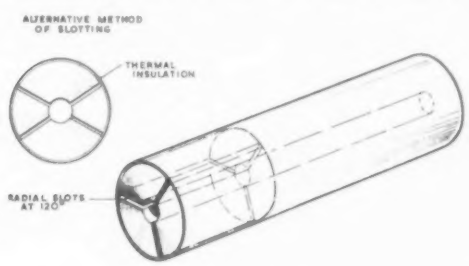


Fig. 4. Slotted tube charge.

The most commonly used charge design is the internal star. All star-centre designs, however, leave slivers which burn out at low pressure and these lead to impulse losses. These losses are appreciable at low altitudes but are quite small at high altitudes, because performance depends on the ratio of the combustion pressure to external pressure rather than on combustion pressure alone.

Sometimes the propellent goes out when the sliver region is reached and the pressure drops suddenly. The losses can then be quite serious. For example, if the slivers remain unburned in a high-altitude research vehicle like Skylark there is not only a loss of total impulse but the weight of the unburned slivers is added to the payload. Losses due to this effect can be reduced by the use of artificial slivers made of a material having a much lower density than the propellent.

Some charges are sliverless and the rod and cylinder is a simple example of one of these. The support of the central cylinder, however, presents certain difficulties and this design is not much used. A more popular design is the slotted tube. Here the decrease in burning surface of the slotted part of the charge is used to compensate for the increase in burning surface of the cylindrical part. At the same time, by putting the slots at the nozzle end of the motor, it is possible to get a stepped conduit.

Motor Hardware

In trying to reduce the weight of the motor casing and nozzle, materials are needed which have high mechanical strength and low density to reduce the weight of the stress-bearing components, and good thermal insulating properties to prevent the stress-bearing components from losing their strength through overheating. These insulating materials, including the nozzle throat, must also have some powers of resistance to chemical attack by the hot propellent gases.

Many current motors in the United Kingdom are made from a chromium molybdenum steel which is wrapped and welded and then heat treated to give a 0.1% proof stress of about 67 tons/sq. in. and an ultimate tensile strength of about 80 tons/sq. in. There is a continual search for suitable steels of higher and higher tensile strength and alloy steels giving ultimate tensile strengths of more than 100 tons are now available for rocket motor manufacture.

There are various other materials which have been applied with more or less success to the manufacture of rocket cases: among these are resin-bonded glass-fibre, steel tape and titanium alloys. Winding methods are attractive for large-diameter motors as they avoid the need for very wide sheets of metal or the heavy equipment for flow turning. All methods of manufacture, however, have their particular problems.

Plastics have very low thermal conductivities and form the basis of most rocket insulating materials. In places where dimensional changes can be tolerated, such as in blast-pipes or the entry sections of nozzles, they can protect the stress bearing components of the motor from the hottest gases for considerable periods of time.

The most commonly used plastics are thermo-setting resins of the phenol-formaldehyde type and these char under the action of heat and produce a layer of hard carbon which is moderately erosion resistant. The thermal decomposition of the heated surface generates gases which pass through the charred surface to produce a measure of boundary layer cooling.

In order to provide sufficient mechanical strength in the insulant, and also to help to bind the charred surface layer together, it is necessary to add some reinforcement to the plastic. This usually takes the form of an inorganic fibre such as asbestos, glass or silica.

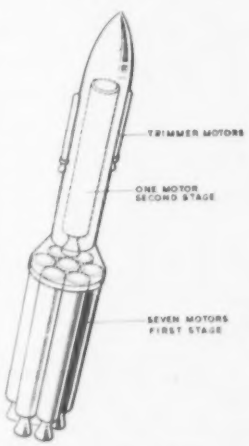


Fig. 5. Two-stage missile with clustered motor, from an early Blue Streak design study.

Solid propellent motors have not yet played more than a subsidiary part in space research. This is mainly because, for the same payload and the same number of stages, they invariably turn out to be heavier than their liquid propellent counterparts. In addition, until quite recently, the size required for the first stage of a vehicle to launch even a satellite of moderate size was much larger than anything of which there was experience.

It is interesting to note that solid propellent motors have mainly been used for the upper stages of space vehicles which, from the point of view of an efficient design, is just the wrong place to use them. A bad staging ratio for the last stage reflects right back to the first stage. However, solid propellent motors are very convenient for staging and clustering and it was probably this and the lack of availability of suitable liquid propellent motors which caused their adoption.

Recently it occurred to various people in the U.S.A. that even though the first stage of a large space vehicle would be heavier if a solid propellent were used rather than liquid propellent it might nevertheless be cheaper. Such a booster would probably be used with liquid propellent motors in the upper stages. Accordingly, NASA issued contracts to a number of American firms to study the feasibility of making large solid propellent motors and to examine the logistics.

There are serious handling and transportation problems concerned with such large solid motors, which may contain a million or more pounds of propellent. Several methods have been proposed.

The first is known as clustering and amounts to putting together a number of units in a bundle. The main problem

is in designing a lightweight structure to hold the motors together.

The second method consists of making the motor in a number of segments which can be put together on the firing site. Clearly the joints between the segments involve some weight penalty, but how serious this is cannot at present be stated. The third method has already been mentioned, and involves casting the propellent into the motor body on the site, which would be a major operation.

So far as the relative costs of comparable liquid fuel and solid fuel motors are concerned the conclusion of one contractor was that the solid propellent motor was a little cheaper than the liquid, but the comparison was very sensitive to the assumptions made. Solid propellent is very much more expensive per pound than that of its liquid counterpart, but this is more or less offset by the high cost of the hardware in a liquid propellent booster.

In the case of very large liquid or solid propellent motors, which will only be used in small numbers, the development cost may well be of the same order as that of the motors produced. Nobody has yet been able to decide which kind of motor would be least expensive to develop.

TABLE I

Measured specific impulse (at 1,000 p.s.i.a.)	
Cordite	190 - 210
Double-base cast	190 - 215
Plastic propellent	170 - 235
Polyurethane propellent	200 - 235
Ammonium nitrate types	180 - 220

Fig. 6. Construction of a large solid propellent motor from segments.

For a large booster motor starting at ground level a mass ratio of 0.90 should readily be achieved, and 0.92 seems possible. An upper stage solid propellent motor should achieve 0.93.

These figures compare with, say, about 0.94 for large first-stage liquid propellent motors. The estimates of mass ratio for solid propellent motors have been derived from the propulsion requirements only, i.e., treating the motor body as a pressure vessel. When assembled into a vehicle various flight loads have also to be taken into account, and these could conceivably modify the picture, although it seems probable that if the upper stages were lightly pressurized for structural stability all would be well.

The Score Mounts

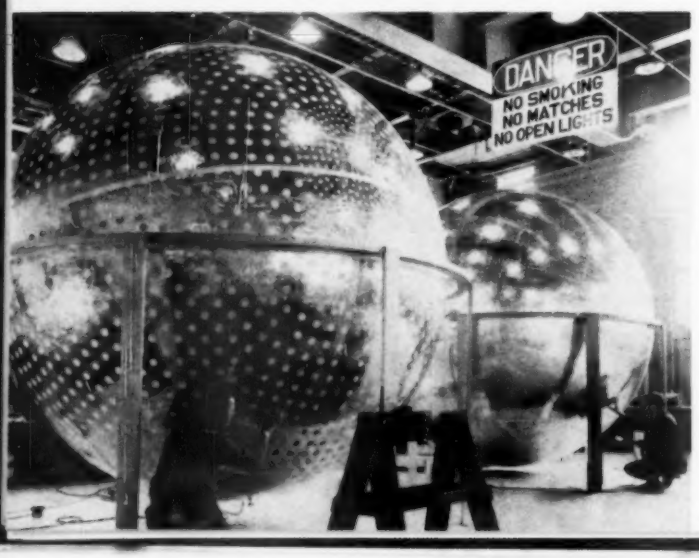
THE number of capsules recovered from polar-orbiting Discoverer satellites is steadily growing. Latest of the series was that from Discoverer XVIII which was successfully "air-snatched" by one of nine patrolling C-119 aircraft over the Pacific Ocean, near Hawaii, on Dec. 10. This was the fourth time recovery had been achieved in six launchings, and the third successful mid-air catch.

On this occasion, the re-entry command signal had been delayed three days until the satellite was on its 48th orbit. This is easily the longest time a satellite has been kept orbiting the Earth before triggering its ejection system and retro-rocket and is a clear indication of the increasing reliability of the Discoverer system. The previous record was held by Discoverer XVII whose capsule was recalled on the 31st orbit.

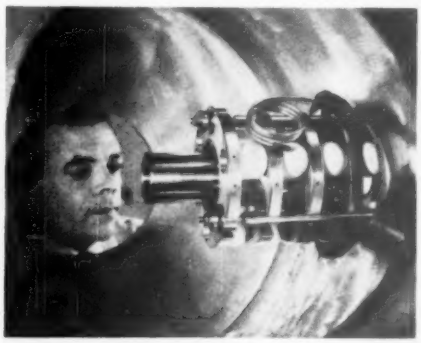
Russia's dog-carrying spaceships (only one of which has been successfully recovered) have been brought back after about 24 hours. The successful recovery of the dogs Strelka and Belka last August was made during the vehicle's 18th orbit.

Discoverer XVIII was launched from Vandenberg Air Force Base on Dec. 7 by a two-stage rocket Thor-Agena B, the upper component of which was an engine system (15,000 lb. s.t.) which is restartable in space. Its 300-lb. capsule contained human bone-marrow, membrane from a human eyelid, and specimens of plant life as part of a radiation experiment.

First of a series of four experiments involving the launching of small monkeys in the bio-packs of Discoverer satellites is expected to begin early next year. Each monkey is intended to complete 17 orbits before returning to Earth within the standard re-entry capsule. Objective is to determine the long-term effects of exposure to weightlessness and cosmic rays.



ION-GUN.—Business end of an ion-engine designed to obtain propulsion in space by the emission of a beam of electrically charged particles. A test model, by Goodrich High-Voltage Astronautics, Inc., was shown at the American Rocket Society's Astronautical Exposition held in Washington from Dec. 5-8.



"Baby Echo" Satellite Experiments

EXPERIMENTS involving the use of 12-ft.-diameter inflatable balloons, for the purpose of obtaining drag measurements in the upper atmosphere, are being made in conjunction with test-launchings of the Chance Vought Scout. First intended firing of the four-stage, all-solid, rocket into orbit on Dec. 4 was frustrated when the second stage did not ignite. The rocket climbed 70,000 ft. and dropped into the Atlantic Ocean some 80 miles off-shore.

Current experiments follow earlier attempts to launch 12-ft. inflatable balloons from Juno I and Juno II satellite launchers on Oct. 23, 1958, and Aug. 14, 1959, respectively. On both those occasions, the launching rocket also failed.

Balloons intended for these early tests were made of Mylar plastic film and aluminium foil. In the 1959 experiment, the satellite was folded into a 7-in. by 31-in. package weighing 25.5 lb., of which 10 lb. comprised the deflated balloon. The ejection and inflating device consisted of a nitrogen bottle, bellows, piston and connecting valve. A 108.03 Mc. tracking transmitter was fitted in the payload casing.

The latest NASA-developed balloon is fabricated in the same way except that its outer skin is painted with 210 1-in.-diameter white spots, to reflect some of the solar radiation when the sphere is in orbit and thus stabilize the internal temperature. It is intended to be tracked optically and by means of a small radio beacon, this time built into the balloon itself.

Although further drag-balloons will be installed in Scout launchers, the next payload in the test series may involve a micro-meteorite experiment.

SPOTTED DICK.—Technicians at NASA's Langley Research Center check the thin plastic skins of two 12-ft.-dia. "Baby Echo" satellites.

Personal Flying

AN executive newcomer, or rather a new version of an established design, is the Morane-Saulnier Paris II, which is powered by two up-rated Turboméca Marboré VI turbojets, developing 1,000 lb. each for take-off. First corporate order for the Paris II is from Herr Quandt, President of the German Aero-Club and a leading industrialist. His will be the 93rd production Paris, and is scheduled for delivery in May next year.

With its increased power, the Paris II has a maximum cruising speed of 377 knots, and has a 1,180-mile range at 350 knots.

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January 8, 1961, marks the 80th birthday of William T. Piper, one of the best-known names in light aviation, and it is also to be the opening date of Piper's new factory at Vero Beach, Florida. First product of the Vero Beach plant was the Pawnee agricultural aircraft, and the new low-price ($10,000 class) Cherokee all-metal four-seater has since been designed and developed at the adjacent Piper Research and Development Center. Its director is the well-known Fred E. Weick, of Ercoupe fame.

Two Cherokee prototypes have so far been built by the R. and D. group, and the first production aircraft may be ready to roll off the assembly line by the time of the official opening. Production of one Cherokee a day is anticipated in March, two per day in April, and five per day later in 1961.

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Since reopening last July, the London Aeroplane Club has gained over 100 members, at Panshanger. Another Super Cub is joining G-ARAO, which has flown 250 hours since July 25 and did 87 in September. The Cubs are £5 per hour dual or solo, and the Club's Piper Caribbean is £7 an hour. At the time of writing, Panshanger is one of the few grass airfields to remain unwaterlogged, which helped Bill Cole, Eric Scrimshire, Vernon Sherriff and John Venner-Pack for their first solos, and Cyril Audrey and Arthur Matthews towards their P.P.L.s. Airwork Services are still moving into their new hangar, soon to be officially opened, and Keegan Aviation, Ltd., are another of the residents. Among the private owners is Colin Chapman, of Lotus car fame, who has a Messenger.

SUPER CESSNA.—The 1961 Cessna 310F features additional rear cabin windows, restyled nose fairing, spinners and tip-tanks. Several internal improvements have also been made

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Now from France comes the news that the first production Wassmer Super IV four-seater touring monoplane has been delivered, and construction is continuing at the rate of two aircraft per month.

The Super IV is an advanced lightplane, with a retractable tricycle undercarriage, and is powered by a 180 b.h.p. Lycoming.

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From the Exeter Aero Club we have heard that Yvonne Pope was recently presented, at a club supper, with a handbag in appreciation of her efforts as an instructor. She has also achieved the distinction of being the first woman to be accepted by M.o.A. to train as an Air Traffic Controller. Other awards during that evening were the Parkhouse Navigation Trophy to Ivan Fisher, and the Unwin Pilot of the Year Trophy to Ian Cummings. The Club is now operating two Chipmunks, two Austers, a Tiger Moth and a Gemini.

Gliding Notes

by Dr. A. E. Slater

A CHANGE of name is announced by the Deutsche Forschungsanstalt für Segelflug (German Research Establishment for Soaring Flight), which was active before the War at Darmstadt and was afterwards reconstituted at Munich. It is now to be called the "Flugwissenschaftliche Forschungsanstalt," the first word indicating "flight-scientific" and meaning that it has no longer confined itself to motorless flight "already for a long time," says *Flugwelt*.

Nor was the original D.F.S. thus confined at the time the War began, though it had done a lot of meteorological research for the benefit of soaring, and produced several new sailplane designs such as the Olympia. Its staff helped to run the ISTUS, predecessor of OSTIV, and in that capacity issued Silver and Gold "C" gliding certificates to all the World.

One wonders whether the new F.F. will interest itself in soaring research at all.

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ONE-DESIGN World Gliding Championships are not yet in sight—or rather, they have disappeared from sight since the Olympia was designed and chosen for an international gliding contest in connection with the Olympic Games of 1940, which never came off. Now, Boris Cijan of Yugoslavia has returned to the subject in a paper published in the OSTIV section of the Swiss *Aero Revue* for December.

Cijan, designer of the Meteor and Orao, who turns up regularly at World Championship meetings, approves strongly of the idea that the Open and Standard Classes should be taken together in evaluating points, instead of separately, so that there would be only one World Champion, irrespective of what class he flew in. But it is not obvious why, if this were done, it "would be a further step forward in the direction of preparation for a One-Design Class," to quote Cijan's words.

If the two classes had been combined for allotting points and designating a champion, there might have been no super-performance Foka, which the Poles produced obviously to win the Standard Class Championship rather than the OSTIV prize, which required its winner to be "cheap, safe and easy to maintain and repair." The only object of producing a 15-metre Standard Class machine then would be to win the OSTIV prize, with its prestige value in promoting sales. (This, by the way, is not what Cijan says.)

Another way to eliminate the Foka would have been, for instance, to set a lower limit to the fuselage cross-section, or perhaps impose other restrictions, too, on the ground that the Open Class is the proper field for unlimited technical developments. But Cijan strongly disapproves of rushing in with still more specifications designed to eliminate "super" machines from the Standard Class.

He lists the Ka-6, Standard Austria, Fauvette, Zugvogel 4, Skylark 2, Mucha Standard, and the Italian, Finnish and American entries of 1960 as "very superior Standard Class sailplanes which are in every way consistent with the Standard Class idea," and as "outstanding contest aircraft"; nevertheless, he thinks that "there are still many improvements that can be made" in their performances "without a great deal of effort or cost." To stimulate developments in performance, he adds, a few "super" types like the Foka serve as an encouragement.

Because of the possibility of this further improvement, it is "far too soon" at present, in Cijan's opinion, to "put any stop on development" by trying to select a one-design type from the available Standard Class machines. In fact, he gives 1968 as the earliest year when it may be possible to "organize" a one-design sailplane for international competitions.

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IN the Kenya highlands the East African Gliding Club keeps going at Nakuru with a Grunau, Cadet and T-31 two-seater; but without the stimulus of new arrivals from England, such as Tony Stocken and Bill Sheppard, formerly of the Army Club, the club would have gone over to private ownership long ago. Mike Garrod writes (he is from the London Club and Dunstable Met. Office). One day in the "dry season" this year each of them broke the local height record in turn, with 16,000 ft. by Stocken, 17,200 by Garrod (up and down in 57 minutes) and 17,600 by Sheppard, all in the Grunau. Cloud base was at over 18,000 ft.

The T-31 was acquired on loan from an inactive group at Kitale and, in order to get it launched in the hot air and light winds, the club had to spend £30 on a 1933 7-litre Rolls-Royce. A badly crashed T-21 is under repair but it will take another year to put the bits together again.

Only one cross-country flight has yet been done from the club, but the next dry season begins in March.

Industry Record

P.T.F.E. Tape

Following the introduction of its range of P.T.F.E. flexible hose assemblies some 12 months ago, the P.T.F.E. Division of William Rose, Ltd., at Brimsdown, Middlesex, is now manufacturing a sealant and insulation tape known as Hilflon P.T.F.E. tape.

Produced from unsintered P.T.F.E., the tape is stated to be chemically inert to such gases and solvents as sulphuric and hydrochloric acid, benzene and carbon tetrachloride. It is unaffected by temperatures ranging from −450° F. to +500° F. and is available in a standard ½-in.-wide roll.

Derby Aviation have for some time been freighting Rolls-Royce Avons from Derby Airport to various foreign destinations. To date more than 100 Avons from the company's Derby and Scottish factories have been delivered to Toulouse, Copenhagen, Stockholm and Algeria.

The Mark 3 Houchin 60-kVA. 400-c.p.s. ground power unit. Electrical control gear is mounted in the withdrawable unit at the left-hand end of the G.P.U., with the engine controls on the fixed panel above.

Ground Servicing Power Unit

Houchin, Ltd., of Ashford, are at present manufacturing a Mk. 3 version of their 60-kVA. 400-c.p.s. ground power unit. Designed to supply AC power for servicing aircraft radio, radar and other electrical equipment, the unit can provide 60-kVA., 200-V., three-phase AC and 10-kW. 28.5-V. DC outputs simultaneously as maximum continuous ratings at aircraft sockets with 80-ft. length power cables.

Mounted on a heavy section fabricated steel chassis fitted with independent rubber suspension, weather protection and Girling brakes, the G.P.U. has a Houchin salient pole, revolving field alternator and an A.E.C. type AV690G six-cylinder industrial diesel engine. It will operate satisfactorily in any ambient temperature between −26° C. and +50° C., and in climates of 90-95% relative humidity, including dust and sand-laden atmospheres.

The AC supply is maintained within ±1% of the nominal voltage under all conditions of load and power factor, and the DC voltage is maintained within ±2½% from no load to full load at the aircraft socket. Once the set has been started and output contactors closed, the clear view panel door over the control panel can be closed. Emergency stop buttons for both AC and DC contacts are positioned outside the weather canopy by the control panel for the emergency shut-down of the electrical supply to the aircraft.

New Electronics Company

An American group, Gulton Industries, Inc., of Metuchen, New Jersey, is to establish a subsidiary company in the United Kingdom. Known as Gulton Industries (Britain), Ltd., it has no address yet, but an existing factory is to be acquired within the next three months.

The parent company's activities are primarily concerned with the relation between energy and material. In recent years it has developed materials which are designed to store the maximum of energy in a minimum amount of space, and can release that energy in fractions of micro-seconds.

Among its products are transistorized power distribution systems for missiles, satellites and space probes, such as Discoverer, Pioneer V and Transit, and a ballistic pendulum which generates single shock pulses of known acceleration and can induce mechanical shocks up to 500 *g*.

The company has also produced transistorized analogue-to-digital converters which can be used in telemetry to convert electrical signals into a pulse code for transmission from a missile to the ground, and a new type of piezo-electric accelerometer developed for missile testing which can be checked and calibrated while it is being used.

Powerplant Monitors

Ultra engine condition analysers have been ordered by B.O.A.C. for installation in the Corporation's Comet 4 fleet. The contract for this new powerplant-monitoring equipment developed and manufactured by Ultra Electronics, Ltd., is worth approximately £31,000.

VC10 Fuel System

The B.O.A.C. fleet of 35 VC10s is to be fitted with fuel contents measuring equipment designed and manufactured by Waymouth Gauges and Instruments, Ltd. This single order, placed by Vickers-Armstrongs (Aircraft), Ltd., is the largest the company has ever received for equipment of this type. The contract also calls for the provision of ground testing and maintenance equipment for B.O.A.C.

The VC10 will have a specially developed version of the Waymouth Type 4 transistorized fuel contents gauge, which will also incorporate facilities for the control of refuelling and defuelling operations during ground handling of the transport. Prototype fuel gauge equipment is at present installed and undergoing test and calibration in the full-scale VC10 fuel system test rig at Weybridge. Delivery of production units from Godalming is scheduled to start in mid-1961.

Aircraft Gyro Reliability

Some interesting facts and figures regarding the performance and reliability of one of the lesser-known aircraft components—the Kelvin Hughes azimuth gyro unit—have been collected by Smiths Aviation Division.

This gyro, although produced originally for use in conjunction with the Smiths Flight System, has since been employed as either the main or standby heading reference for the gyro-magnetic compasses of several military aircraft. To date, more than 1,000 units have been produced and are in service.

One of the largest civil users is B.E.A., which has been operating its Smiths Flight System-equipped Viscount 800s since 1957. The Corporation's Comet 4Bs and Vanguards are similarly equipped. A service analysis covering 52 of these gyros which were removed by B.E.A. during the six-month period ended September, 1960, shows that more than 90% of them achieved their time-expiry life within the maintenance scheduling practised by the airline. Between them, they clocked up a total of more than 130,000 hr. and, taking into account unscheduled changes, returned an average overhaul life of 2,500 hr.

Eleven gyros each completed 3,000 hr. or more. During the peak summer months of operation there were only six unscheduled changes, and the worst defect rate per 1,000 aircraft hr. was 0.3, the best being 0.1. Since each aircraft uses two azimuth gyros, the actual unit defect rates per 1,000 hr. are only half those stated above.

These facts and figures confirm the early promise of reliability shown by the introductory period when the Viscount 800 was coming into service. A similar analysis covering that time (February-September, 1957) records that during the first 20,100 hr. operation there were 11 unscheduled gyro changes, not all of which were due to defective azimuth gyro units.

It was mainly on the strength of its performance during this introductory period that B.E.A. obtained approval for raising the overhaul life of the gyro from the provisional 1,500 to 3,000 hr. Since that time a further increase has been permitted, and the Corporation's gyros are currently being run for as long as 3,200 hr. between overhauls, with the possibility of extending this to 3,500 hr. in the near future.

Correspondence

Inverting a Tiger

IN your issue of Jly. 15, 1960, you have an article about the Lockheed Trophy Competition. I understand that the Tigers as modified to "Deacon" and "Archbishop" have an inverted fuel system. Generally, a Tiger cannot fly inverted and the Gipsy I have cannot either—for neither the fuel nor the oil runs in.

I should be grateful if you would give me further information also about the carburetter (or injection system?) and the oil system used. Also if the systems are approved by M.o.A. I would also like the addresses of the firms concerned, please.

Copenhagen, Denmark. B. MICHELSEN.

Prestwick for Glasgow

DOMESTIC airline operators, the rest of the World over, commonly demand that they shall be permitted to operate from the airports to and from which the international airlines fly: this is because quite a substantial proportion of their traffic is that connecting with the international services.

Unless, therefore, the argument is put forward that Prestwick could not cope with the domestic traffic in addition to its international traffic, surely the Minister of Aviation ought not to spend additional public money to set up a separate airport for Glasgow to replace the unsuitable Renfrew (and Abbotsinch is unlikely to be nearer in journey time to the centre of Glasgow than Prestwick could be).

The total failure since the War to provide a decent train service to Prestwick (where now the runway has been extended right up to the railway about a mile from the existing station) has meant that:—

(a) the vast majority of normal traffic between Glasgow and Prestwick/Ayr is carried by double-decker buses, which run more than three services per hour throughout the day, all the year round, whereas, for example, British Railways run about two trains in the whole of Sunday;

(b) has forced B.O.A.C. (who carry the international airline passengers to and from Glasgow for all the airlines operating from Prestwick) to run a fleet of special coaches just for this job; but also

(c) it allows the other nationalized transport operator, viz., B.E.A., to say that "the interests of internal passengers [would be] better served by using an airport nearer to Glasgow than [is] Prestwick."

B.E.A.'s comment must be respected from their limited point of view, but currently B.E.A. carry very few indeed of the passengers for the international services from Prestwick (largely because the connection between Renfrew and Prestwick is so tedious that most passengers prefer to go to Prestwick by other means). But airport plans are for the years ahead, and since these envisage a large increase in the international traffic from Prestwick (including freight on a large scale) being drawn from the environs, a good train service from Glasgow will be essential in any case, but the delay to international passengers brought from other parts of Scotland by B.E.A. will be one of hours to get from Abbotsinch to Prestwick.

The reason we tolerate transport monopolies in this country is on the understanding that the operator takes the rough with the smooth: it is all very well for B.E.A. to say "let others operate the international feeder air services to and from Prestwick": they know only too well that this traffic *alone* is not sufficient at present, it's all "rough"—whilst they carry only the domestic traffic, and to make it "smooth" for them, they are going to give very poor service indeed to the international passengers through Prestwick.

Yet if Prestwick (which is *essential* as a diversionary airport because it is the only fog-free airport in the U.K.) could handle all the Glasgow area air traffic—domestic and international—(and this is something I would suggest the Minister should give his views on) B.E.A. would be doing justice to the "rough" as well as to the "smooth" by operating to Prestwick when Renfrew closes, and the overall economy would benefit everyone (the taxpayer not least!).

For one thing, Prestwick, Manchester and London all have runways capable of taking the largest aircraft in existence: to make the new Glasgow runway far shorter than either of the other two are now would one day preclude operation of such types of aircraft into the "Glasgow domestic" airport: for many years airline traffic is expected to go on doubling every five or six years (as it has been doing in the past) so the time when very large aircraft will be needed may be no more than 10 or 12 years off: then the folly of choosing an unnecessarily short runway for Glasgow will have to be paid for by the passengers in higher fares.

Lytham St. Annes, Lancs. J. F. Foss. (A.F.R.Ae.S.)

Fowler Flap

PERMIT this engineer an indulgent smile at the pretentious word-boxing of your new literary find, "Dai Bach," on the Correspondence page. On Nov. 4, p. 625, he splits an addled egg with Mr. Geoffrey Dorman. In the Nov. 18 issue, p. 698, he lays an ostrich egg on my doorstep. Both these eggs have the faint odour of that very superior person, "the literary gent," more attuned to the schoolroom than the rough and tumble of the workshop or the give and take of the design office.

But it is diverting to hear that my brief news note of Nov. 4 on the DC-8 has been fashioned into a complaint hook upon which D.B. seeks to hang his overstuffed fowler hat. (The "fowler" is basically a bowler with blinker flaps over the ears and eyes.) I am a little stunned, however, at the thought of Britain's future aeronautical engineers being urged to stuff English courses in Quiller-Couch, Charles Lamb, the Fowler

Wroundabout

Ring Out The Old. I have sometimes wondered if we Western people weren't clinging too much to past things like Edwardian fashions, ancient customs, veteran cars and aeroplanes, vintage railway engines and so on, while the Russians were pressing on grimly with satellites and other scientific and commercial achievements. So it is mildly soothing to hear that the Russians have just completely restored Lenin's 1919 Rolls-Royce tourer to its original condition. But only for the Lenin Museum.

*

Line Shot

A 148 Sqn. navigator was talking to two A.T.C. cadets at the station sports meeting. On learning of his calling, one cadet turned to the other and said "*They're* intelligent, you know."

*

*

Flying By The Book. From a Christmas list of secondhand books: *Dorman, Geoffrey*: "British Text Pilots."

*

Course Humour

Air Traffic Controller to aircraft: "How are you progressing?"

Pilot, cheerfully: "Well, it's this way—we're lost but we're making very good progress."

*

Proper Perspective. I have brighter news for "Cap" Capper who, you may have noticed, has been protesting against airlines calling turbo-props "jets." A Canadair news release about the delivery to Quebecair of their first 540 states rather modestly: "The airline expects to be among the first regional airlines in the world to have an all-turbine fleet." Now we're getting somewhere.

by Wren

brothers and the King James Bible in between their thermo-aerodynamics and engineering fundamentals. And what if one prefers the more elegaic cadence of Thomas Gray or even the rugged and rhythmic verse of Rudyard Kipling?

In airing his fourth-form erudition, D.B. is straining at the literary cockshy and missing the milk-and-money engineering of the coco-nuts. I was aiming for the coco-nuts, as evidenced in the parasitic pods, peduncles, stalks or pylons that clutter up the current crop of American jetliners and bombers. The bull may be colour-blind, but need D.B. pose total blindness? It now being my turn to confess, I will admit that it is disappointing to fish for a sophisticated aerodynamicist and hook a literary minnow. I would prefer to see D.B. vent his wordage on the design art, a vastly more difficult discipline than stringing one-syllable words together in the image of his old English master.

I am mildly perturbed at being classified, even obliquely, as a "writer"—after some 40 fascinating years as a practising aircraft designer. The engineer writes up and plots his data without thought of literary immortality, pretensions which are more common to the literati. When I have something to say that is worth passing on to my younger professional brethren, I must fashion it in my own damned tinker's technique; such modest writing endeavours are addressed to the avoidance or recognition of engineering pitfalls, not literary ones. The literary scarecrows, to which D.B. so solemnly genuflects, impress me not at all. They are the dusty, boneless strawmen flapping in the breeze.

The working engineer who becomes too involved in the anæmic niceties of classical English or the didactic pedantics of the schoolmen flapping themselves into a bookish tizzy—with the Fowlers as shot-gun umpires—might as well change jobs. My boyhood heroes were neither Roman nor Greek (nor English masters!) but an unlettered Tynes'de "Geordie" named George Stephenson and, later, the Wright brothers. Their monuments still speak for them, if sometimes a little too violently; but to me, at any rate, these voices are more pregnant with virility than the flat two-dimensional technique of the writer, especially those addicted to "the flabbier kind of journalese," to quote Fowler, p. 721.

To get back to the aeronautical menu: the prime dish is the aeronautical meat, not the literary horse-radish. (The choice of sauce is clearly a matter of personal taste, anyway.) May I then venture the good-natured suggestion to D.B. that there are other, more interesting, non-Oxbrigian Fowlers to flap about in the pages of an aeronautical journal.

Santa Monica, U.S.A. STANLEY H. EVANS.

In Favour of Heresy

DID I detect a slightly sour note in Dr. Slater's comments on the new Réné Fournier light aircraft? (Dec. 2.) It would be a pity if Dr. Slater is persuaded by his purist principles to denounce as heresy anything which does not conform to some accepted class of sailplane.

Whilst I would share with him the pure ecstasy of being lifted from the shoulders of willing helpers into a stiff breeze over a hilltop and the satisfaction of locating a thermal and centring in it, I would remind Dr. Slater that sophisticated soaring these days usually requires one to be dragged into the sky behind a noisy "avion" using hundreds of chevaux, leaving below the army of helpers with their towing vehicles.

What does it matter if the Fournier is an "avion" or a "planeur"? If one can take off unaided, cruise economically at 90 m.p.h. and occasionally indulge in the joys of silent soaring, all in a very handsome little aircraft, then I for one am all in favour.

Yeovil, Som. LYNDON G. MCFARLANE, A.F.R.Ae.S.

Was Stout the First to Simplicate?

FOR some time I have been under the impression that one of the late Mr. C. G. Grey's favourite quotations "Simplicate and add more lightness" was inspired by Mr. Bill Stout who (so I thought), besides being a rather original aircraft designer, was also something of a business efficiency expert. I have the idea that Bill Stout originated the slogan as "Simplicate and add more efficiency" and that he wrote a book on this subject. Can any more enlightened reader tell me if: (1) Mr. Stout ever wrote such a book; (2) if ever any other American efficiency expert expressed his experiences in writing; and (3) if so, can this book be obtained through the American Chamber of Commerce?

Billesley, Birmingham. MAURICE AUSTIN.

Publications Received

DH—An Outline of de Havilland History, by C. Martin Sharp. Tells factually and in detail the story of de Havilland—the man and the company. Copiously illustrated, with long informative captions, and supported with appendices detailing the type of aircraft and aero-engines built, and other useful tabulations. 420 pp. 5½ in. by 8½ in. Faber and Faber. Price 2 guineas.

A Pride of Unicorns, by John Pudney. Biography of the Atcherley twins, David and Richard, who identified themselves completely with the spirit of the R.A.F. itself. The Unicorns of the title are "the innovators who challenge convention, create a tempo of their own and live to see their ideas and attitudes adopted by the Lions," the author's name for the Establishment. This book shows the Atcherleys to have been archetypal Unicorns. 240 pp. 5½ in. by 8½ in. Illustrated. Oldbourne Book Co., Ltd. Price 21s.

Hover Craft, by Angela Croome. The title is misleading, for this is the story not simply of ground effect machines ("hovercraft") but of all the many ways in which hovering flight has been attempted, starting (inevitably) with Daedalus and Icarus. The text gives a good overall account of rotary-wing development without becoming involved in a type-by-type listing and comes up to date with reference to the various types and possible applications of ground effect machines. 72 pp. 9 in. by 7½ in., attractively illustrated by photographs, line drawings and sketches. Brockhampton Press, Ltd. Price 15s.

Guide to Civil Land Aerodrome Lighting. British Standard 1332:1960. A new edition of the standard first published in 1932, now based on the I.C.A.O. Annex 14, third edition, of September, 1958. 48 pp. 5½ in. by 8½ in. Published by the British Standards Institution. Price 12s. 6d.

Goods by Air. A booklet on air freight services, intended as an elementary guide for businessmen who have not used air transport and a handbook for those who have. Includes a comprehensive list of airlines, forwarding agents and air brokers. 28 pp. 6 in. by 9 in. Published by Chamber of Commerce Publications, 68 Queen Street, London, E.C.4. Price 2s. 6d.

Aerodynamics for Engineering Students, by E. L. Houghton and A. E. Brock. A text-book designed for the aeronautical engineer in the earlier years of their specialist studies, and also suitable for the A1 and A2 levels of the Higher National Certificate and Diploma Courses. 448 pp. 6 in. by 9¼ in. Illustrated. Edward Arnold (Publishers), Ltd. Price 45s.

Aviation Calendar

Dec. 20

London Airport Central.—Institute of Transport West Middlesex Group lecture, "Organization and Methods Work in Air Transport," by P. Garner and D. Hollings, in the 3rd floor Conference Room, Control Tower, at 18.30 hrs.

London.—R.Ae.S. lecture, "Aircraft Shapes and their Aerodynamics for Flight at Supersonic Speeds," by Dr. D. Küchemann, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Dec. 21

London.—The Kronfeld Club Christmas Party in the Basement, 74 Eccleston Square, S.W.1.

Dec. 22

London.—R.Ae.S. 4th Lanchester Memorial lecture, "British Universities and Aeronautical Research," by Prof. A. D. Young, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Jan. 3

London.—R.Ae.S. Astronautics and Guided Flight Section lecture, "Planning of Missile Acceptance Trials," by J. F. W. Mercer and A. R. Cawthorne, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Jan. 4

Weybridge.—R.Ae.S. Branch lecture, "An Experiment in Vertical Take-off," by D. Keith Lucas, at the Apprentice Training School, Vickers-Armstrongs (Aircraft), Ltd., at 18.00 hrs.

Hull.—R.Ae.S. Brough Branch lecture, "Problems of Rocket Engine Development," by A. V. Cleaver, in the Royal Station Hotel, at 19.30 hrs.

London.—British Institution of Radio Engineers Radar Group lecture, "Automatic Techniques in Civil Air Line Communications Systems," by W. E. Brunt, in the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, at 18.30 hrs.

Hatfield.—R.Ae.S. Branch lecture, "The Development of the Aircraft Carrier," by Capt. Short, in the de Havilland Restaurant, at 18.15 hrs.

New Patents

APPLICATIONS ACCEPTED

859,458.—**E. W. Broden.**—"Release mechanism for bombs and the like."—Apr. 22, 1959.

859,627.—**Bendix Corporation,** formerly **Bendix Aviation Corporation.**—"Clamp ring release mechanism."—Mar. 25, 1959 (Mar. 28, 1958).

859,504.—**Fairey Co., Ltd.,** formerly **Fairey Aviation Co., Ltd.**—"Mechanism for deflecting a control surface of an aircraft."—Aug. 9, 1957 (May 9, 1956).

859,543.—**United Aircraft Corporation.**—"Aircraft auxiliary power generating systems."—Aug. 26, 1958 (Sept. 3, 1957).

859,539.—**P. B. Fondeo** and **K. O. T. Walander.**—"Storage appliances for aeroplane arresting gear."—Aug. 5, 1959 (Aug. 28, 1958).

859,670.—**P. B. Fondeo** and **K. O. T. Walander.**—"Arresting nets for aeroplanes."—Aug. 5, 1959 (Aug. 28, 1958).

859,758.—**P. B. Fondeo** and **K. O. T. Walander.**—"Arresting nets for aeroplanes."—Aug. 5, 1959 (Aug. 28, 1958).

859,993.—**Boeing Airplane Co.**—"Retractable noise suppressor for jet propulsion engines."—Jne. 20, 1958.

Printed specifications of the above will be available on Jan. 25, 1961, and the opposition period will expire on Apr. 25, 1961.

Personal Notices

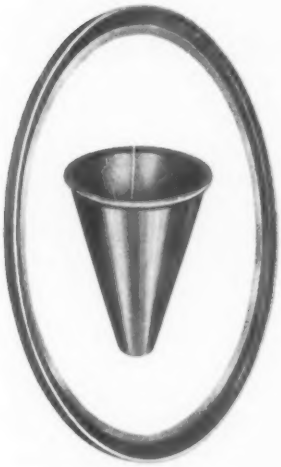
BIRTHS

Coutts Milne.—On Nov. 29, at R.A.F. Hospital, Ely, to Joyce (*née* Howell), wife of Flg. Off. Bryan Coutts Milne—a son.

Garrett.—On Dec. 2, at R.A.F. Hospital, Nocton Hall, Lincoln, to Beryl (*née* Richens), wife of Flt. Lt. Keith A. S. Garrett—a son.

Hunter-Tod.—On Dec. 3, at Princess Mary's R.A.F. Hospital, Halton, to Anne (*née* Howard), wife of Gp. Capt. J. H. Hunter-Tod—a son.

At Delaney Gallay



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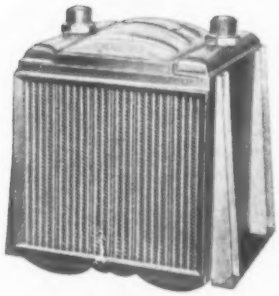

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Classified Advertisements for the issue dated DECEMBER 30 must reach us not later than first post WEDNESDAY, DECEMBER 21.

Telephone instructions can be accepted up to noon.

All instructions should be addressed to The Manager, Classified Advertisement Department,

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM DON EVERALL (AVIATION), LTD., OF ELMDON AIRPORT, BIRMINGHAM, 26:—

APPLICATION NO. 4651 for permission to transfer the following existing or proposed services to Air Safaris, Ltd.:—

(i) Existing U.K. Internal Services:—
Birmingham-Guernsey (opt.)-Jersey. Coventry-Birmingham (inward flights only)-Guernsey (opt.)-Jersey.—Application No. 9.
Wolverhampton (opt.)-Birmingham-Coventry (opt.)-Leicester East (opt.)-Isle of Wight (Bembridge or Sandown).—Application No. 454.
Birmingham-Coventry (opt.)-Exeter.—Application No. 3251.

(ii) Existing Inclusive Tour Services approved in conjunction with Transglobe Ltd.:—
Birmingham-Malaga.—Application No. 3601.
Birmingham-Rimini.—Application No. 3602.
Birmingham-Perpignan.—Application No. 3603.
Birmingham-Basle.—Application No. 3604.
Birmingham-Nice.—Application No. 3605.

(iii) Proposed U.K. Internal Service:—
Birmingham-Newcastle.—Application No. 4625.

FROM B.K.S. AIR TRANSPORT, LTD., OF BERK HOUSE, BAKER STREET, LONDON, W.1, and BRITISH EUROPEAN AIRWAYS OF BEALINE HOUSE, RUISLIP, MIDDLESEX:—

APPLICATION NO. 4650 for permission for B.K.S. Air Transport, Ltd., to transfer to B.ritish European Airways the Normal Scheduled Service which the company are at present authorised to operate under Application No. 1621 on the route Southend and/or London Airport-Bordeaux or Dinard (tech.)-Oporto, at a frequency in accordance with traffic demand; and for permission for British European Airways to transfer to B.K.S. Air Transport, Ltd., a number of direct flights on the Normal Scheduled Service which the Corporation are at present authorised to operate under Application no. 165 on the route London-Bordeaux and/or Biarritz, at a frequency in accordance with traffic demand, so as to enable the company to operate direct flights between London and Biarritz at two-sevenths of the combined frequency operated by both parties on services terminating at Biarritz.

FROM SKYWAYS COACH AIR, LTD., OF 7 BERKELEY STREET, LONDON, W.1:—

APPLICATION NO. 310/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate with Dakota, Hermes and Constellation aircraft between Manston or Lympne and Beauvais, at a frequency of 21 return flights daily until March 31, 1962, so as to enable them to operate with Avro 748 aircraft in addition to the types at present authorised, and also for permission on March 30 and April 3, 1961 to operate four return flights on each day between Luton and Beauvais with aircraft chartered from Autair, Ltd.

FROM STARWAYS, LTD., OF LIVERPOOL AIRPORT, LIVERPOOL, 24:—

APPLICATION NO. 2383/1 for an extension from April, 1961, to December, 1968, of the period of approval of the U.K. Internal Service which they are authorised to operate with Dakota and DC-4 aircraft between Liverpool (Speke) and Glasgow (Renfrew) at a frequency of four return flights weekly, and also for permission to operate at an increased frequency of 10 return flights weekly increasing later in accordance with traffic demand.

FROM SCOTTISH AIRLINES (PRESTWICK), LTD., OF PRESTWICK AIRPORT, AYRSHIRE:—

APPLICATION NO. 113/2 for permission to transfer to Dan-Air Services, Ltd., the seasonal U.K. Internal Service which they are at present authorized to operate with Dakota and Twin Pioneer aircraft between Glasgow (Prestwick) and the Isle of Man (Ronaldsway) at a frequency of 12 return flights daily from May 1 to September 30 each year until September 30, 1960.

FROM DERBY AVIATION, LTD., OF BURNASTON AIRPORT, DERBY:—

APPLICATION NO. 143/14 for permission to operate at the company's discretion with Heron aircraft chartered from Overseas Air Transport, Ltd., in addition to the aircraft types at present approved on the following services:—

Nottingham and/or Derby and/or Northampton-Wolverhampton (opt.)-Birmingham (opt.)-Guernsey and/or Jersey.—Application No. 143.

Luton (opt.)-Northampton (opt.)-Derby-Isle of Man.—Application No. 473.

Derby-Nottingham (opt.)-Birmingham-Ostend or

Derby - Luton - Southend (opt. tech.) - Ostend.—Application No. 487.

Cambridge and/or Luton-Bournemouth (tech.)-Guernsey and/or Jersey.—Application No. 1604.

Derby and/or Staverton and/or Oxford-Bournemouth (tech.)-Jersey.—Application No. 2083.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 565-1

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INDEX TO ADVERTISERS

Name	Page
A	
Aero-Enterprises (Boreham Wood), Ltd.	20
Airline Air Spares, Ltd.	21
Air Registration Board	8
Airwork, Ltd.	22
Avica Equipment Ltd.	3
B	
Blackburn Aircraft Ltd.	7
Boulton Paul Aircraft, Ltd.	4
B.P. Aviation Services	23
British Aircraft Corporation	10
British Airline Pilots Association	24
British European Airways	9, 24
Bryans Aeroquipment Ltd.	6
C	
Central Office of Information, R.A.F. Recruiting	12, 13
Convair; A division of General Dynamics Corporation	1
Cross Manufacturing Co. (1938) Ltd.	21, 22
D	
Decca Radar Ltd.	Inside Back Cover
Delaney Gallay Ltd.	19
Dowty Rotol Ltd.	Inside Front Cover
E	
Elliott Brothers (London) Ltd.	2
English Electric Aviation Ltd.	17
H	
Hawker Siddeley Aviation Ltd.	14, 23
J	
Jeppesen & Co. G.m.b.H.	6
L	
Lucas Gas Turbine Equipment Ltd.	Back Cover
M	
Marconi's Wireless Telegraph Co. Ltd.	16
Marshalls Flying School, Ltd.	21, 22
Ministry of Aviation	21
R	
Redifon Ltd.	18
Rolls-Royce, Ltd.	15
Rubbaglas, Ltd.	24
S	
Sampson Low	8
Shackleton, W. S., Ltd.	20
Short Brothers & Harland Ltd.	Front Cover
Silver City Airways Ltd.	21
Southend Municipal Flying School	24
Staravia, Ltd.	22
U	
United Aircraft Export Corporation	5
V	
Vickers-Armstrongs (Aircraft) Ltd.	11
Vigors Aviation Ltd.	20

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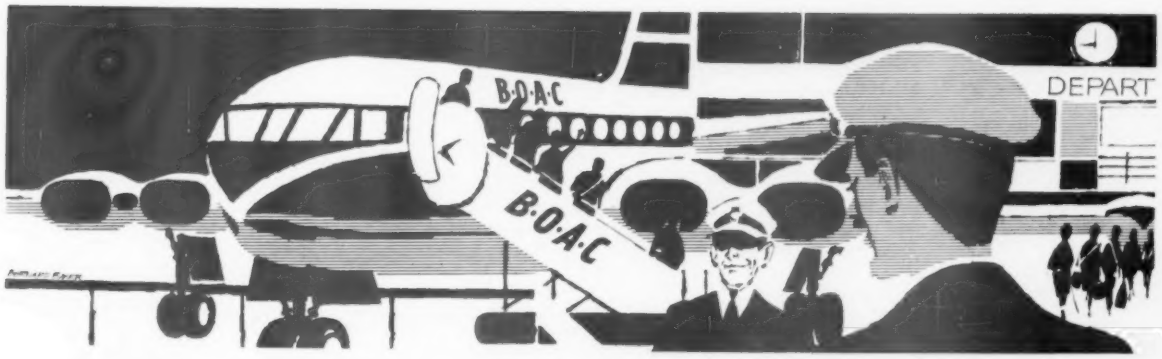

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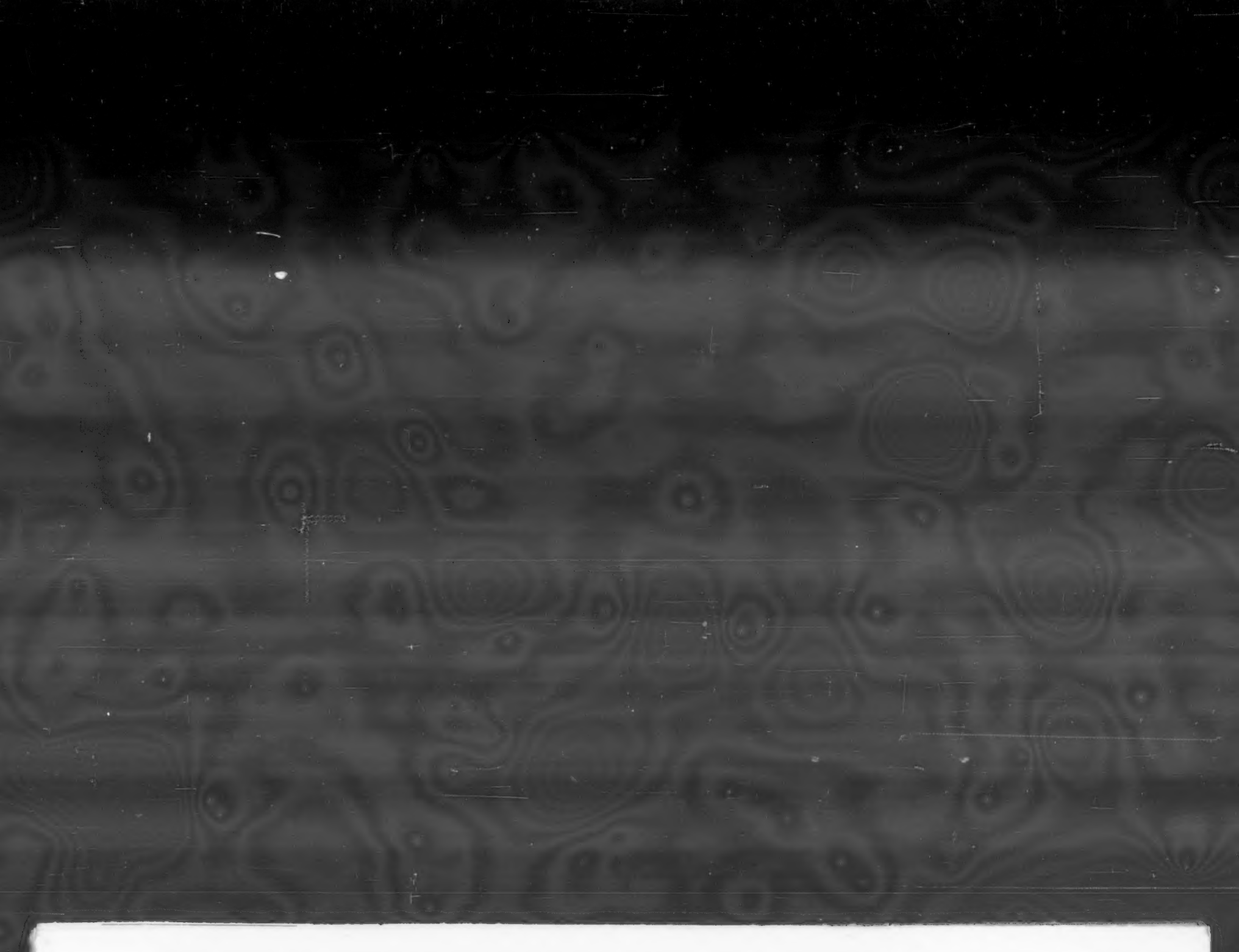
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